REPORT ON THE QUALITY OF THE INTERSTATE WATERS OF THE LOWER PASSAIC RIVER AND UPPER AND LOWER BAYS OF NEW YORK HARBOR

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SUMMARY

1. Section 10 of the Federal Water Pollution Control Act, as amended, authorizes the Secretary of the Interior to call a conference regarding the pollution of interstate waters if requested to do so by the Governor of a State, or when, on the basis of reports, surveys, or studies, the Secretary has reason to believe that pollution of interstate waters is endangering the health or welfare of persons in a State other than that in which the discharge or discharges originate.

2. The first session of the Hudson River conference was held in September, 1965, at the request of the Governors of New York and New Jersey. Subsequent sessions, to review compliance with initial conference recommendations and discuss new problems, were held in September, 1967 and June, 1969. Recommendations of the conference as approved by the Secretary state in part that "...All wastes prior to discharge into the waters covered by the conference (a) shall be treated to provide a minimum of 80 percent reduction of biochemical oxygen demand at all times. It is recognized that this will require a design for an average removal of 90 percent of biochemical oxygen demand. Or (b) shall be treated, as approved by the State Water Pollution Control Agency, to the degree necessary to meet the water quality standards approved by the Secretary of the Interior under the Water Quality Act of 1965. All the waters covered by the conference shall receive effective disinfection of the effluents as required to protect water uses..." and "...the following time schedule for the foregoing remedial program: a) designs for remedial facilities completed by January 1, 1967; b) financing arrangements completed by April 1, 1967;

c) construction started by July 1, 1967; d) construction completed and plants placed into operation by January 1, 1970...". The complete recommendations of the Secretary for the first and second sessions and the recommendations to the Secretary by the conferees for the third session are contained in the Appendix of this report.

3. At the June, 1969 session, preliminary reports were presented by the Federal Water Pollution Control Administration regarding the operation of the Passaic Valley Sewerage Commissioners' waste treatment facility, direct discharges to the Lower Passaic River and the effect of the direct discharges on water quality in the Lower Passaic River. Since that session, additional studies have been conducted by the Federal Water Pollution Control Administration to evaluate the operational efficiency of the Passaic Valley Sewerage Commissioners' waste treatment facility and the effect of its effluent on the water quality of the Upper and Lower Bays of New York Harbor. Studies were also conducted by the Federal Water Pollution Control Administration and the New Jersey State Department of Health to identify waste discharges to and evaluate the water quality of the Lower Passaic River.

CONCLUSIONS

1. The quality of the interstate waters of the Upper and Lower Bays of New York Harbor and the Passaic River is below that required by the approved Federal-State Water Quality Standards. In the interstate waters of New Jersey, the present standards prescribe the highest use as follows: in the Upper Bay — limited recreation and fish survival and in the Passaic River

upstream to the head of tide-fish survival. In the interstate waters of New York, the present standards prescribe the highest use as follows: in the Lower Bay-bathing and in the Upper Bay-fishing.

2. The quality of water in the Upper and Lower Bays of New York Harbor is affected by the discharge of inadequately treated waste from Passaic Valley Sewerage Commissioners and other discharges originating in the New Jersey-New York City Metropolitan area.

3. As a result of inadequately treated wastes originating in Upper Bay of New York Harbor, a public health hazard exists in the waters of Lower Bay which are classified for recreational purposes. Pathogenic organisms have been isolated in the effluent of the Passaic Valley Sewerage Commissioners, in the waters of Upper Bay of New York Harbor, in the vicinity of Passaic Valley Sewerage Commissioners' dispersal field and in the waters off the bathing beaches of the Lower Bay of New York Harbor.

4. Most of the municipalities and industries in the conference area are moving to meet the conference recommendations.

5. The Passaic Valley Sewerage Commissioners have not initiated adequate action to comply with the conference recommendations for needed treatment facilities.

6. Court action against the Passaic Valley Sewerage Commissioners for not complying with New Jersey treatment requirements was initiated in 1967 by the New Jersey State Department of Health. The Chancery Division of the Superior Court and the Appellate Division of the Superior Court upheld the Department's orders in dealing with the quality of effluent discharges from the Commissioners' facility.

7. The enforcement responsibilities of Passaic Valley Sewerage Commissioners to maintain the quality of the Passaic River as prescribed by the enabling legislation are not being carried out.

8. Industrial and untreated municipal waste discharges are degrading the quality of water in the Passaic River.

RECOMMENDATIONS

1. The Passaic Valley Sewerage Commissioners take necessary action without further delay to comply with the administrative order dated August 9, 1966, issued by the State of New Jersey and with the previous recommendations of this conference.

2. The Passaic Valley Sewerage Commissioners take necessary steps to insure that present and future pollutional sources in the service area of the Commissioners utilize the regional treatment facilities completely for final disposal of wastes.

3. The Passaic Valley Sewerage Commissioners provide a minimum of 80% reduction of biochemical oxygen demand for all wastewater in accordance with the schedule established by the conference. This requires a design for an average reduction of 90% of biochemical oxygen demand as required by the recommendations of the Hudson River Conference. As an immediate measure, effective chlorination, in accordance with State requirements, be provided to reduce the health hazards from the Passaic Valley Sewerage Commissioners' effluent in the Lower Bay of New York Harbor.

4. Municipalities in the Passaic Valley Sewerage Commissioners' service area initiate remedial action to eliminate illegal connections to storm sewers.

5. The Passaic Valley Sewerage Commissioners improve the present method of controlling combined sewer overflows in its intercepting sewer system. Existing manually operated by-pass valves be replaced by an automatic regulating system.

INTRODUCTION

Section 10 of the Federal Water Pollution Control Act, as amended, authorizes the Secretary of the Interior to call a conference on the pollution of interstate waters if requested to do so by the Governor of a State, or when, on the basis of reports, surveys, or studies, the Secretary has reason to believe that pollution of interstate or navigable waters is endangering the health or welfare of persons in a state other than that in which the discharge or discharges originate.

The first session of the Hudson River Conference was held in September, 1965 at the request of the Governors of New York and New Jersey and on the basis of reports, surveys, or studies. This conference brought together interested Federal, State, interstate and local agencies to discuss the pollution problems of the interstate waters of the Hudson River and the New York Metropolitan Area.

During the conference the New Jersey conferee delivered a statement from the Passaic Valley Sewerage Commissioners. The statement dealt with the area and population serviced by the Commissioners and the policing duties performed in connection with water pollution control regulation of the Passaic River and its tributaries below Great Falls. The Commissioners reported that through their efforts, pollution emanating within their jurisdiction had been effectively controlled. Some of the problems faced by the Passaic Valley Sewerage Commissioners' primary treatment plant were presented as well as the actions planned for correcting them.

The second session of the Hudson River Conference was convened in September, 1967 to review compliance with initial conference recommendations and to discuss new problems. The New Jersey conferee reported on recent legal actions taken against polluters with particular reference to the State's injunctive proceeding to require the Passaic Valley Sewerage Commissioners to comply with the requirement for post chlorination.

A third session of the conference was held in June, 1969. The conferees reviewed progress of pollution abatement programs established by the States of New York and New Jersey and the Interstate Sanitation Commission. Special attention was focused on the significance of combined sewer overflows in the conference area.

A report on an inspection of the Passaic Valley Sewerage Commissioners' waste treatment facility conducted in June, 1969 was presented by the Federal Water Pollution Control Administration. This report indicated that to improve the effectiveness of treating the average flow into the plant, all existing sedimentation basins should be in operation. At the time of the inspection 20 of the 60 basins were out of operation. It appeared that routine maintenance of the operating basins was not adequate to insure their proper operation. Additional statements were also made regarding the number of direct discharges into the Passaic River and the resulting degradation of water quality.

The State of New Jersey reported that all governmental agencies within the conference area, except Passaic Valley Sewerage Commissioners, had complied with directives to provide effective post-chlorination of the effluent every year during the period of May 15 to September 15. The New Jersey conferee further stated that court actions had been initiated against the Passaic Valley Sewerage Commissioners for: (a) failing to meet the requirement for chlorination and (b) for not acting toward compliance of a previous order to provide adequate treatment as required by the approved standards.

Appendix A contains the conclusions and recommendations of these three conference sessions. The major conference recommendations require that "... All wastes prior to discharge into the waters covered by the conference shall be treated to provide a minimum of 80 percent reduction of biochemical oxygen demand at all times. It is recognized that this will require a design for an average removal of 90 percent of biochemical oxygen demand. All the waters covered by the conference shall receive effective disinfection of the effluents as required to protect water uses..." The conferees agreed that all remedial facilities be placed in operation by 1970 except the proposed North River facility which cannot be completed and in operation until 1972.

Subsequent to the third session, the Federal Water Pollution Control Administration conducted additional studies to evaluate the operational efficiency of the Passaic Valley Sewerage Commissioners' waste treatment facility and the effect of its effluent on the quality of the interstate waters of Upper and Lower Bays of New York Harbor. Surveys were also initiated along the Passaic River to identify the direct discharges to the River and define the quality of water resulting from these discharges. Similar studies had been carried out in May, 1967 at the Passaic Valley

Sewerage Commissioners' treatment facilities and in August, 1968 along the Passaic River. This report has been prepared to present the results of these studies and to recommend improvements to the Passaic Valley Sewerage Commissioners' waste treatment facilities.

DESCRIPTION OF THE PASSAIC RIVER BASIN

The Passaic River Basin, situated in northeastern New Jersey and southeastern New York, drains an area of approximately 935 square miles. The Basin is roughly elliptical in shape with a northeasterly length of about 56 miles and a maximum width of 28 miles. It spans across eight counties in New Jersey (Bergen, Essex, Hudson, Morris, Passaic, Somerset, Sussex and Union) and two counties in southeastern New York (Rockland and Orange).

The headwaters of the Passaic River are located north of Millington, New Jersey. From Millington, the River flows northeast for about 32 miles to the Great Piece Meadows above Caldwell, New Jersey, and continues east for 16 miles to Great Falls near Paterson, New Jersey. At Paterson, the river turns due south for 24 miles to its confluence with Newark Bay. The last 17 miles of the Passaic River from Dundee Dam to Newark Bay are tidal.

The Basin can be divided into three distinctly separate physiographical regions: The Highland Area in the northwest part of the Basin, comprising about 55 percent of the total watershed area; the Central Basin located in the southerly portion of the watershed and representing a little over 25 percent of the total area; and the Lower Valley comprising only about 20 percent of the watershed area and located in the eastern fringe of the Basin.

The Highland area is characterized by broad ridges and narrow valleys with terrain that is rugged and wooded. It contains many natural and man-made lakes. The area is sparsely settled and supports minor industrial activity.

The Central Basin consists of small hills, flat meadows and extensive areas of fresh water swamps. The major part of this Basin is rapidly undergoing residential and commercial development.

The Lower Valley is similar in physiographic characteristics to the Central Basin. It is essentially a flat, wide, flood plain with abutting low rolling hillsides. The area is densely populated and contains some of the most highly developed land in New Jersey. Extensive industrial activities are concentrated in the Valley.

The population of the Basin in 1968 totaled about 2,000,000 persons, the majority of which are located in the highly urbanized Lower Valley. Population densities varied from a low of about 130 persons per square mile in Sussex County to a high of 7,140 persons per square mile in Essex County.

At least 155 municipal and 23 industrial facilities discharge treated wastewaters into the Passaic River Basin. The majority of the municipal facilities, all generally located in the Highland and Central Basin areas, provide secondary treatment with chlorination to a total flow of approximately 50 mgd. The Passaic Valley Sewerage Commissioners, the largest wastewater collection and treatment facility in the Basin, handles the domestic and industrial wastes primarily within the Lower Valley. The Commissioners' plant, serving 1,200,000 people, nearly three-fifths of the total sewered population in the Basin, discharges primary treated effluent without disinfection into the interstate waters of Upper Bay of New York Harbor.

The main stem of the Passaic River below the confluence with the Pompton River is considered interstate water under Section 10 of the Federal Water Pollution Control Act, as amended. The classifications established for these interstate waters are given below. Detailed definitions of these classes and their criteria are provided in Appendix B.

WATER	CLASSIFICATION	HIGHEST USE
Newark Bay	TW-3	Navigation not recreation
Passaic River (main stem from mouth to head of tide at Dundee Lake Dam)	TW-3	Navigation not recreation
Passaic River (main stem and tributaries between Dundee Lake Dam and Little Falls)	FW-3	All recreational purposes but not for public potable water supply
Passaic River (main stem between Little Falls and its confluence with the Pompton River)	FW-2	Public potable water supply after treatment and all recreational purposes

Background

The Passaic Valley Sewerage Commissioners were established by three acts of the New Jersey legislature: 1) New Jersey Public Law 1902, Chapter 48, which outlined the boundaries of the Passaic Valley Sewerage District to include almost the entire watershed of the Passaic River; 2) New Jersey Public Law 1907, Chapter 10, which provided for the purification of the waters of the Passaic River within the District from any polluting matter, made provision for the treatment of sewage, and authorized the Commissioners to sell bonds if necessary to raise funds for the construction of sewage treatment facilities; and 3) New Jersey Public Law 1907 New Jersey Statutes Annotated (NJSA) 58:14-1 to 14-34 (1907) which created an authority to coordinate the planning and financing of sewage disposal and water pollution control within the Passaic Valley Sewerage District and authorized participating municipalities, through the sale of bonds or borrowing of money, to raise funds needed to pay the Commissioner's charges and/or the cost of constructing connecting sewer lines.

The Governor of the State of New Jersey appoints the five commissioners of the Passaic Valley Sewerage Commissioners who each serve a five year term in office. Appointments are made so that, as far as practicable, each section of the District is represented.

A 1910 stipulation between the Federal government, represented by the Secretary of War, and the Passaic Valley Sewerage Commissioners outlined requirements and results which the Passaic Valley Sewerage Commissioners had to meet in the construction and operation of its treatment facilities. Among the conditions of the stipulation were: "...1) there will be absence in the New York Bay of visible particles coming from the Passaic Valley sewage; 2) there will be absence of deposits objectionable to the Secretary of War of the United States in the New York Bay coming from the Passaic Valley sewage; 3) there will be absence in the New York Bay and its vicinity of odors due to the putrefaction of organic matters contained in the Passaic Valley sewage thus discharged; 4) there will be a practical absence on the surface of New York Bay of any grease or color due to the discharge of the Passaic Valley sewage at the dispersion area or elsewhere; 5) there will be no injury to the public health which will be occasioned by the discharge from the said sewer into the Bay of New York in the manner proposed and no public or private nuisance will be created thereby; 6) there will be absence of injurious effect from said sewage discharge, upon the property of the United States situated in the Harbor of New York; and 7) there will be absence of reduction in the dissolved oxygen contents of the waters of New York Bay resulting from the discharge of Passaic Valley sewage, to such an extent as to interfere with major fish life...."

The original Passaic Valley Sewerage Commissioners' contract with municipalities within the District was dated May 15, 1911. This contract was revised on September 20, 1911, and was signed by 15 participating municipalities The contract: 1) determined the specifications for construction of the Passaic Valley Sewerage Commissioners intercepting sewer or sewers, the treatment plant and a suitable discharge point; 2) estimated the probable cost for construction, operation, and maintenance; 3) authorized expenditures by the Commissioners of

$11,250,000 for the construction of sewers, plant and disposal facilities; 4) authorized the contracting municipalities to sell bonds; 5) provided for obtaining the necessary property rights to construct a sewer system and treatment plant; 6) stated that the Passaic Valley Sewerage Commissioners shall without restriction exercise the powers granted to them under the provisions of State law; and 7) established a method for determining municipal costs for sewage treatment based on estimated flow and sewer line capacity.

Subsequent contracts, between 1911 and 1925, authorized increased funds for the construction of the Passaic Valley Sewerage Commissioners' sewer lines and treatment plant. Municipal shares of construction costs and interest rates were to be apportioned according to original contract provisions. The last two contracts, between Passaic Valley Sewerage Commissioners and participating municipalities, dated October, 1926 and October, 1942, outlined the procedures that a municipality must follow to receive the benefits of increased capacity of the Commissioners system.

As of January, 1925, 20 municipalities were under contract with the Passaic Valley Sewerage Commissioners. Over the course of time, other municipalities in the four county area (Bergen, Essex, Hudson, Passaic) of northern New Jersey contracted for sewage treatment, bringing the number of municipalities totally or partially served to 29. Table 1 identifies these municipalities and Figure 1 outlines the service area. Out of the eight municipalities partially served by the Passaic Valley Sewerage Commissioners system, two (Glen Rock, Fairlawn) discharge the remainder of their waste as treated effluent into tributary waters of the Passaic River. The remaining six municipalities (Lyndhurst, North Arlington, Rutherford, Kearny, East Orange, and Newark) dis-

TABLE 1

MUNICIPALITIES SERVED BY THE
PASSAIC VALLEY SEWERAGE COMMISSIONERS

Bergen County	Essex County
East Rutherford (Discharge #1)	Belleville
Garfield	Bloomfield
Lyndhurst (70%)	East Orange (Partial)
North Arlington (76%)	Glen Ridge
Rutherford (54%)	Montclair
Wallington	Newark (72%) (Discharge #2)
Glen Rock (Partial)	South Newark
Fairlawn (Partial)	Nutley
East Paterson	Orange
Lodi	
Saddle Brook Twp.	**Passaic County**
	Clifton
Hudson County	Haledon
East Newark	Passaic
Harrison	Paterson
Kearny (Partial)	Prospect Park
	Hawthorne

Note: Percentages in parenthesis indicate portion of municipality served by PVSC.

Source: PVSC Report on Proposed Head End Facilities, December, 1968.

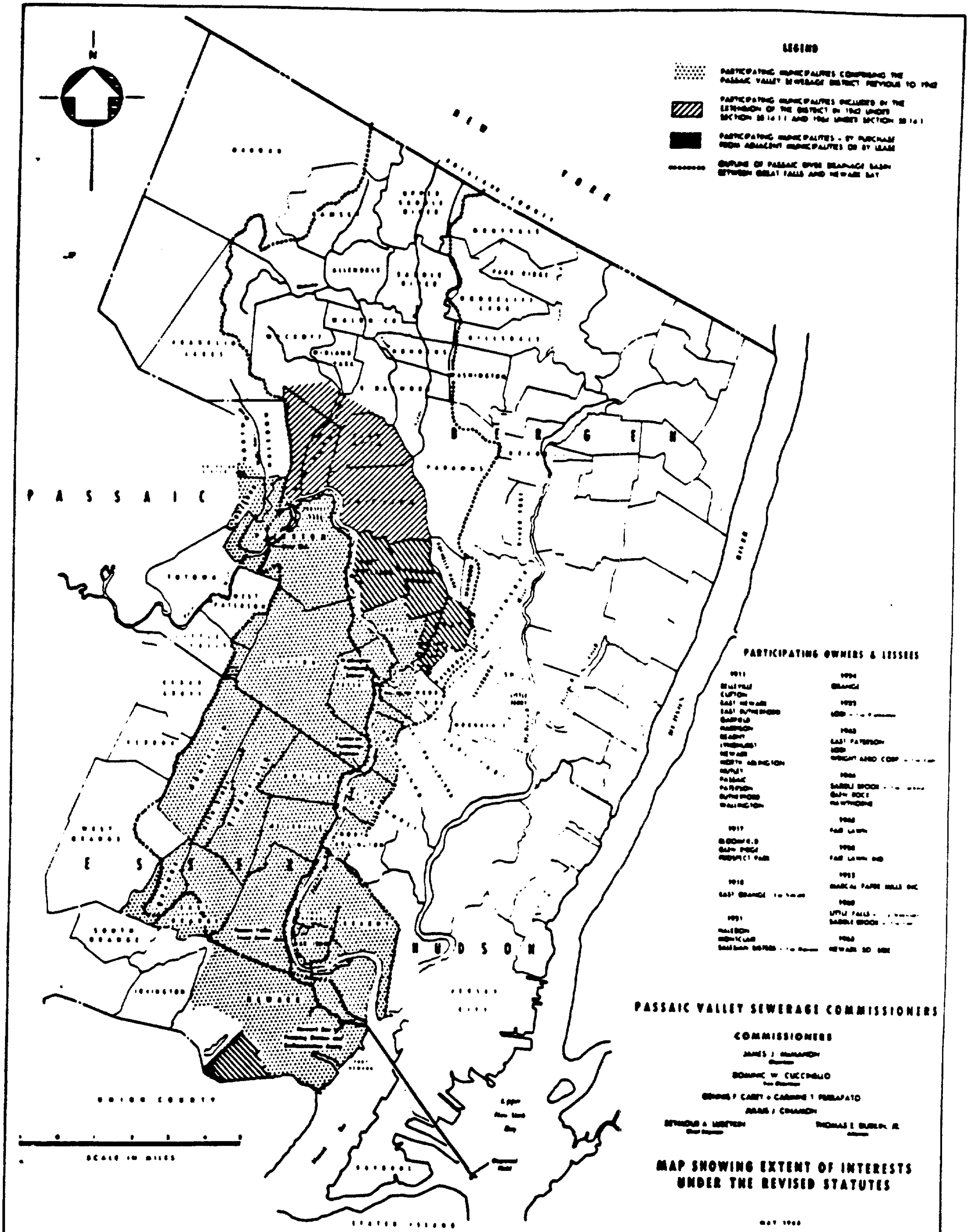

Figure 1

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charge the remainder of their waste as treated effluent outside the Passaic River Basin.

An important provision of the operation of the Commissioners' system allows the leasing of sewage capacity to any new participant if this does not conflict with the original flow and capacity allotted to the contracting municipalities. However, the Commissioners cannot lease such sewage capacity if municipalities representing more than 75% of the allotted capacity, object to such leasing of sewage capacity.

The Passaic Valley Sewerage Commissioners, under the requirements of the several acts of the New Jersey legislature and the contracts with the municipalities of the District, are empowered to establish the annual costs for maintenance, repair and operation of their system. These costs are allocated to each of the participating municipalities, based on flow and capacity. Statements made at a previous conference session indicate that the charges assessed by the Passaic Valley Sewerage Commissioners to contracting municipalities are below those of sewerage authorities and municipalities providing similar services in the area.

<u>Description of Waste Treatment Facilities</u>

The Passaic Valley Sewerage Commissioners operate an extensive water pollution control system which collects and treats the wastes from approximately 1,200,000 persons in 29 municipalities and over 700 industries located within the four North Jersey counties of Bergen, Essex, Hudson and Passaic. The system consists of interceptor sewers, treatment facilities, outfall works and sludge handling facilities.

There have been a number of reports prepared by consultants to the Passaic Valley Sewerage Commissioners which evaluate and recommend measures required to improve the operation and effectiveness of the system. These reports include:

Consultant	Title of Report	Date
Bogert-Childs Engineering Associates	Report on Improving Sedimentation and Dispersal Facilities at Newark Bay Pumping Station	May, 1951
Bogert-Childs Engineering Associates	Critical Situation as to Steam Power, Newark Bay Pumping Station	March, 1952
Bogert-Childs Engineering Associates	Report on Repairs, Replacement and Improvements at Newark Bay Pumping Station	May, 1954
Metcalf & Eddy Engineers	Reports on Improvements to Sewage Treatment Facilities at the Newark Bay Pumping Station	1960, 1962
Manganaro, Martin & Lincoln	Report on Proposed Chlorination Facilities	April, 1967
Manganaro, Martin & Lincoln	Report on Proposed Head-End Facilities	December, 1968

The implementation of the recommendations resulting from the above studies primarily included:

(1) Expansion of pumping capacity

(2) Mechanization of sedimentation basins

(3) Improvement of sludge storage and processing facilities.

Recommendations regarding the installation of new grit and screening facilities which date back to 1954 have not been implemented although modifications to the existing equipment were made. These modifications however, have not eliminated the problems at the treatment plant resulting from poor grit removal.

The installation of chlorination facilities as required by New Jersey State Order has not been implemented. This project is reportedly being delayed pending evaluation of new grit and screen facilities and the effect on chlorination facilities after secondary treatment has been provided.

Intercepting Sewers

Two intercepting sewers, the Main Interceptor and the South Newark Interceptor, collect and transport wastewater to the treatment facilities on Newark Bay in the vicinity of Port Newark (see Figure 1). The Main Interceptor which originates within the City of Paterson below Great Falls and parallels the Passaic River for about 27 miles, receives the flow from most of the participating municipal sewer collection systems including the larger industries. Its diameter ranges from four feet at its origin to 13.5 feet at the Newark Bay Pumping Station. Several of the municipal collection systems receive excessive flow during storm periods since storm water and sanitary waste are all or partially combined. Considerable infiltration is also experienced since many of the separate sanitary collection facilities are old and subject to ground water seepage. Since the Main Interceptor was not originally designed to accommodate all flows during storm periods, about 50 by-passes were provided to discharge combined sewer overflows to the Passaic

River. These by-passes are regulated by manually operated valves. In the past, maintenance crews, on 24-hour alert, were sent out to open the by-passes whenever flows were expected to exceed the safe pumping station operating load of 225 mgd. This operational practice, which was necessary to protect the Newark Pumping Station from flooding, often resulted in the opening of the by-passes during non-rainfall periods. For example, during the period January-September, 1953, by-passes were open approximately 60 percent of the time. Pump replacement projects in 1953, 1954, and 1964 increased the maximum pumping capacity to 660 mgd. No data are available to indicate the present frequency of by-pass to the Passaic River of raw sewage during periods of wet weather or high infiltration. Many of the participating municipal collection systems also have their own overflow by-passes which discharge untreated wastewater to the Passaic River during periods of rainfall and high infiltration.

In 1966, the South Newark Interceptor was installed. This interceptor collects the wastes from 100,000 people and several industries located in the South Newark area. This waste was previously discharged untreated to Petty Ditch near Newark Airport. In April, 1969 a faulty valve at the pumping station made it necessary to discharge about 30 mgd of raw wastewater to Petty Ditch rather than into the interceptor line. This condition existed until October, 1969 when temporary repairs were made.

Treatment Facilities

The Passaic Valley Sewerage Commissioners' waste treatment facility is located in Newark, New Jersey adjacent to the New Jersey Turnpike Bridge over Newark Bay. Their primary treatment facilities consist of screens, grit chambers, pumps, sedimentation basins and sludge handling facilities.

The original screening facilities consisted of three sets of coarse bar screens located at the effluent end of the grit chamber and three sets of fine screens located in the screen house at the Main Pumping Station. These screens, which remove the larger particles of suspended and floating solids, were cleaned manually by raking and scraping the solids away into containers or trucks for final disposal. The study by Bogert-Childs Engineering Associates in 1954 recommended replacing the original facilities with mechanically cleaned coarse screens and hydraulically cleaned fine screens before and after four new grit chambers. This recommendation was not implemented but, in 1961, improvements to the screening facilities were made by the installation in each existing grit channel of bar screens with mechanically operated cleaning rakes. The study of December, 1968 by Manganaro, Martin and Lincoln recommended that new screening facilities of adequate capacity be provided.

The existing grit chambers, which are the original facilities installed in 1924, consist of three channels each approximately 35 feet long, 16 feet wide and 44.5 feet deep with overhead grit removal facilities. The study of 1954 found these facilities to be obsolete and ineffective, and indicated that large quantities of inorganic solids were being carried through the main pumping station to the sedimentation basins causing numerous mechanical breakdowns. It was recommended that four new grit chambers equipped with mechanical grit collection facilities replace these obsolete facilities. Another study in 1960 by Metcalf & Eddy Engineers indicated that, based upon operating experience, grit removal was seldom a problem, although the unequal distribution of grit between the three channels during high flow conditions did result in carry over of grit into the sedimentation basins. The study recommended certain improvements to the existing grit removal facilities along with new grit washing equipment. The study in 1968 again investigated the most effective means for removing and disposing of grit, screenings, grease and oil and recommended new grit removal and screening facilities.

The original pumping facilities at the treatment plant consisted of four steam-driven centrifugal pumps rated at 100 mgd each. During the period 1953-1956, two of these units were replaced with electric-driven constant speed centrifugal pumps, each with a rated capacity of 130 mgd. The two remaining pumps were replaced in December, 1964 by two diesel-driven, variable speed centrifugal pumps each with 200 mgd maximum capacity. These facilities provide a pumping capacity of 660 mgd which appear to be sufficient to handle the peak sewage flow into the plant. It should also eliminate the need for by-passing raw sewage directly into the Passaic River from the interceptors except during periods of intense storm water runoff and infiltration. The pumping capacity exceeds the present treatment facilities design capacity of 225 mgd.

The Gate House, also known as the valve chamber or Venturi meter chamber, contains the control devices which divert flow into the effluent conduit leading to the sedimentation basins or to a by-pass conduit leading directly to Newark Bay.

The 1954 report revealed that one of the Gate House sluice gates was inoperable and remained open serving as a constant drain of raw sewage through the by-pass conduit to Newark Bay. It is not known what, if any, corrections or improvements have been made on these facilities. In addition, no information is available to indicate how extensively this by-pass conduit is used.

The sedimentation basins, which are forty years old, are grouped into three units: Unit 1 has 24 tanks, each approximately 25 feet by 104 feet; Unit 2 has 20 tanks, each approximately 25 feet by 72 feet; Unit 3 has 16 tanks, each approximately 22 feet wide by 84 feet long. These basins are designed for a flow of 225 mgd. Mechanical sludge scrapers operate the length of each tank and cross collectors scrape collected sludge from groups of tanks into hoppers at the influent end. Sludge is withdrawn from the basins through automatic valves and two 20 inch cast iron sludge pipes to the sludge pumping station. During a Federal Water Pollution Control Administration inspection in June, 1969, several of the automatic sludge valves were inoperative and were being manually controlled. The report on Proposed Head End Facilities, 1968, indicated that the overflow rates based on average annual flows for these sedimentation basins, exceed the nominal allowable rates established by the New Jersey State Department of Health Rules and Regulations for plants with secondary treatment. The report states that "...To meet this accepted norm, more than a doubling of present basin area is required (in addition to secondary treatment)..."

Although some improvements have been made over the years, namely the mechanization of the basins, performance has been plagued by operational problems which result in frequent shut-down of these basins for repair. Major difficulties are caused by the inadequately designed grit-removal and screening facilities which allow grit to enter the sedimentation basins. These inorganic materials cause mechanical equipment failures, interfering with mechanical collection and removal facilities. The inadequate basin capacity and a nominal maintenance program also cause inefficient operation of these basins.

The head house contains eight cylinder-operated cast iron sluice gates. Two gates, normally left open, convey treated effluents to the outfall shaft. The remaining six gates are on the by-pass conduit to Newark Bay.

The sludge pumping station contains four sludge recirculating pumps and four raw sludge pumps. Sludge from the sedimentation basin hoppers flows to the station wet well, where it is normally pumped to thickeners, storage tanks and finally barges for disposal at sea. Withdrawn sludge can also flow directly to the barging facilities by means of the old sludge line. The Corps of Engineers, New York District has reported that for the period of July, 1968 through June, 1969, 92 sludge trips were made to dump 706,800 cubic yards of sludge in the sludge disposal area in the New York Bight.

The Commissioners recently converted the two original 100 foot diameter by 25 foot high sludge storage tanks to sludge thickening tanks and constructed two new 80 foot diameter by 40 foot high sludge storage tanks and a sludge storage building with sludge pumps, boiler and instrumentation for sludge equipment and piping. The construction of these new facilities provides capacity for better sludge thickening and dewatering as well as reduces the necessity for sludge recirculation back to the sedimentation basins.

Three sludge lagoons have been constructed adjacent to the sludge tanks to receive scum and supernatent from the thickeners, thickened sludge from the storage tanks and for emergency storage purposes. At the time of an inspection by the Federal Water Pollution Control Administration in June, 1969 it appeared that these beds were not being operated as intended. Weeds were observed growing in the beds.

The outfall works consist of the conduits, shafts, tunnels and dispersal facilities from the head house to Robbins Reef in Upper New York Bay. The 14-foot diameter Newark Shaft descends nearly 250 feet to a 10.5-foot by 12.5-foot tunnel which extends about 9,000 feet under Newark Bay to the 12-foot diameter Bayonne Shaft, where the flow rises 70 feet to a second segment of the outfall tunnel. The second segment, a 12.0-foot diameter tunnel, extends about 17,000 feet past the Jersey City Shaft to the 12.0-foot diameter Terminal Shaft where the flow rises 60 feet to the Terminal Chamber. Two 96-inch diameter pipes carry the flow from the Terminal Chamber to the 3.5 acre dispersal field off Robbins Reef where the waste is discharged through 150 diffusion nozzles spaced at 10-foot centers.

Estimates of Flow

Information contained in the 1968 report shows that during the period 1961 to 1967 flows into the Passaic Valley Newark Bay Plant varied considerably with an annual average daily flow ranging from about 182 mgd to 232 mgd. Peak hourly flows were estimated at 136 percent of the daily flow. The report also showed that major industrial activities contribute over 57 mgd or about one-third of the tributary flow into the Passaic Valley Sewerage Commissioners' collection system.

Recent information from Passaic Valley Sewerage Commissioners indicates that the average flows into the Newark Bay facility range from 240-250 mgd. Using 136 percent of the daily flow and 240 mgd as an average flow, the peak hourly flows are estimated at 326 mgd. In addition hourly flows reaching the treatment facilities during periods of storm are reported to exceed 500 mgd. The Federal Water Pollution Control Administration study in 1967 found an hourly flow rate approaching 420 mgd. Based upon these flow conditions and the capacities previously discussed for the existing facilities, it is apparent that present average daily flows exceed the design capacity of the primary treatment facilities.

Recent Developments

In April, 1965 New Jersey State Department of Health advised the Commissioners that chlorination of the effluent would be required from May 15 and September 15 beginning in 1967. The State Health Department (under the Public Sanitary Sewerage Facilities Act of 1965) assisted the Commissioners by providing a $20,000 grant for a feasibility study of the required chlorination facilities.

On August 9, 1966, the New Jersey State Department of Health pursuant to R. S. 58:12-2 ordered that the Passaic Valley Sewerage Commissioners "...must and shall, prior to December 1, 1966, cease the discharge of improperly , inadequately and insufficiently treated sewage into the waters of Upper New York Bay, being waters of this State, and must alter, add to or improve the sewage treatment plant operated by the said Passaic Valley Sewerage Commissioners in order that the sewage received therein shall be cared for, treated, and disposed of and the effluent discharged into the said waters in a manner approved by the State Department of Health of the State of New Jersey, and in order that the treatment and disposal of said effluent shall meet the applicable standards of water quality prescribed by regulations of the State Department of Health entitled 'Classification of the Surface Waters of the Hudson River, Arthur Kill and Tributaries', effective May 16, 1966..." Copies of the orders of April, 1965 and August, 1966 are contained in Appendix C.

The Passaic Valley Sewerage Commissioners did not comply with the Health Department's requirement for chlorination, and in March, 1967 the Department reaffirmed its order. Since the Commissioners did not noticeably improve the quality of its effluent entering the Upper Bay of New York Harbor, the Department brought suit against the Commissioners in October, 1967.

The Commissioners, in presenting their case in November, 1967 stated that their facilities were not subject to State regulatory authority because of the stipulation between the Commissioners and the Federal Government. The Passaic Valley Sewerage Commissioners further stated that more time was needed to construct the chlorination facilities which would improve the quality of the effluent.

The Health Department contended in its suit that it had the authority to regulate the Passaic Valley Sewerage Commissioners' facilities under its broad jurisdiction over any pollution which may pose a threat to, or may injure any inhabitants of, the State of New Jersey.

The Chancery Division of Superior Court supported the State Health Department's authority in this matter, and ruled in April, 1968 that the State Health Department orders "...deal with the intensity of effluent treatment afforded by defendant's facility which at this time discharges inadequately treated wastes into waters outside the defendant's jurisdiction...", and, "...the Legislature did not delegate to the Passaic Valley Sewerage Commissioners and the contracting municipalities absolute discretion over the determinations of treatment plant 'unit design'..."

Furthermore, the court stated, "...scientific progress and the Federal Water Pollution Control Act of 1948 and its amendments have brought such radical changes in national water pollution control policy that the direct working arrangement between the defendant (Passaic Valley Sewerage Commissioners) and the United States embodied in the 58 year old stipulat.on now appears anachronistic...".

With reference to Section 10(c) of the Federal Water Pollution Control Act, as amended, regarding the authority of State Governors or their designated water pollution control agencies to develop water quality criteria, the court ruled that the New Jersey State Department of Health did have the authority to issue pollution abatement directives to the Commissioners.

The court also found that the time given the Commissioners to chlorinate and to clean up the treatment plant effluent by the Health Department was within reason.

About 15 years ago, the highway pavement over the Main Interceptor at McCarter Highway and Governeur Avenue in Newark settled. On November 20, 1967 an examination was conducted and it was determined that there was a break in the sewer. Consultants were engaged to evaluate the problem and in June, 1969 five proposed alternative methods of repairing the damaged section of the trunk sewer were suggested. The method selected by the Passaic Valley Sewerage Commissioners proposed an internal repair of the sewer with a resulting diversion of about 115 mgd of raw sewage to the Passaic River during an estimated six week repair period. Since the by-passing of raw sewage to the Passaic River could represent a health hazard, the State Department of Health ruled this solution to be unacceptable. In July, 1969 a State Legislative Committee held a hearing to review the imminent danger to public safety created by the break and the public health hazard that can result from the proposed by-pass of raw sewage to the Passaic River. The Committee heard testimony and recommended that Passaic Valley Sewerage Commissioners avoid any repair scheme that involved the by-passing of raw sewage. The Committee suggested that pumping sewage through pipes around the section of sewer to be repaired be considered as the preferred solution to the problem.

The Passaic Valley Sewerage Commissioners have recently initiated a bill (#719) in the state legislature that would authorize an increase in the Passaic Valley Sewerage Commissioners' bonding limits. This bill has been passed by the Senate but not the Assembly. With the passing of this bill, the Passaic Valley Sewerage Commissioners could be assured of increased bonding authority for future construction.

STUDY OF PASSAIC VALLEY SEWERAGE COMMISSIONERS WASTE TREATMENT FACILITY

On May 14-15, 17-18, and 19-20, 1967 and August 19-20, 1969, 24-hour studies were conducted by the Hudson-Delaware Basins Office, Federal Water Pollution Control Administration at the Passaic Valley Sewerage Commissioners' waste treatment facility. Plant influent (every two hours) and effluent (every hour) were sampled during each survey. Total and fecal coliform densities were determined on the basis of samples taken every four hours during each 24-hour sampling period. The results of each survey are summarized in Table 2. The data generally compare with values reported by the Passaic Valley Sewerage Commissioners.[12/] High values for flow, BOD, COD, TOC and total suspended solids show the effects of runoff caused by a storm that occurred during the May 17-18, 1967 sampling period.

Primary treatment facilities which receive only typical domestic sewage can be expected to provide 25-40 percent removal of five day BOD, 40-70 percent removal of suspended solids, 75-100 percent removal of settleable solids and 25-75 percent reduction of bacterial concentrations.[14/]

Table 3 presents a performance summary for the four 24-hour surveys conducted by Federal Water Pollution Control Administration. The BOD loading discharged from the plant during the 1969 study was 467,000 pounds per day. Percent BOD removal was about 13 percent. During the 1967 surveys the percent removal ranged from 0 to 13 and the daily BOD loading discharged averaged 589,000 pounds. Total suspended solids discharged in the 1969 survey was 269,000 pounds per day with a percent removal of 60. Percent removals during the 1967 studies ranged from 22 to 69 and the estimated amount of total suspended solids discharged averaged 415,000 pounds per day. The per-

TABLE 2
DATA, FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
STUDY OF PASSAIC VALLEY SEWERAGE COMMISSIONERS
WASTE TREATMENT FACILITY 1/

Study Date	Flow mgd	BOD 2/ mg/1	TOC 3/ mg/1	COD 4/ mg/1	Total Settleable Solids ml/1	Total Suspended Solids mg/1	Total Volatile Suspended Solids mg/1	pH	TKN 5/ mg/1	Total Coliform Geometric Mean Million/100 ml	Fecal Coliform Geometric Mean Million/100 ml
					INFLUENT						
Aug. 19-20, 1969 Tue.-Wed.	234	263 6/	266	689	7.4	346	268	6.8	48	230.0	14.0
May 19-20, 1967 Fri.-Sat.	246	297	289	986	22.0	374	282	5.8	38	6.6	1.3
May 17-18, 1967 Wed.-Thurs.	258	384	335	1,122	23.0	437	319	5.8	30	5.9	1.4
May 14-15, 1967 Sun.-Mon.	210	241	192	576	23.8	281	210	7.8	28	11.9	0.6
					EFFLUENT						
Aug. 19-20, 1969 Tue.-Wed.	234	231 6/	209	593	1.8	138	98	6.8	43	270.0	11.0
May 19-20, 1967 Fri.-Sat.	246	295	222	769	2.1	177	120	6.8	35	14.3	2.0
May 17-18, 1967 Wed.-Thurs.	258	334	251	900	5.4	230	152	6.5	35	16.1	2.2
May 14-15, 1967 Sun.-Mon.	210	252	151	481	11.7	219	161	7.9	25	16.0	0.82

1/ Data represents an average of all analysis made on samples taken over the 24-hour period of sampling

2/ BOD: 5-Day 20°C Biochemical Oxygen Demand

3/ TOC: Total Organic Carbon

4/ COD: Chemical Oxygen Demand

5/ TKN: Total Kjeldahl Nitrogen

6/ Based upon 4.5 day BOD determined in the Laboratory

TABLE 3
PERFORMANCE SUMMARY
PASSAIC VALLEY SEWERAGE COMMISSIONERS
WASTE TREATMENT FACILITY

Date of Survey	Flow mgd	5-Day BOD mg/l Inf.	5-Day BOD mg/l Eff.	5-Day BOD % Rem.	Est. BOD Disc. #/Day	Total Suspended Solids mg/l Inf.	Total Suspended Solids mg/l Eff.	Total Suspended Solids % Rem.	Est. Total Suspended Solids Disc. #/Day	Total Settleable Solids ml/l Inf.	Total Settleable Solids ml/l Eff.	Total Settleable Solids % Rem.
Aug. 19-20, 1969 Tue.-Wed.	234	274 1/	239 1/	12.8	467,000	346	138	60.0	269,000	7.4	1.8	76.0
May 19-20, 1967 Fri.-Sat.	246	297	295	0.7	606,000	374	117	69.0	364,000	22.0	2.1	90.0
May 17-18, 1967 Wed.-Thurs.	258	384	334	13.0	719,000	437	230	47.0	496,000	23.0	5.4	77.0
May 14-15, 1967 Sun.-Mon.	210	241	252	0.0	442,000	281	219	22.0	384,000	23.8	11.7	51.0

1/ Based upon 4.5 day BOD determined in Laboratory and adjusted to 5-Day BOD assuming a typical k rate value for raw and settled sewage using: $Y = L\,(1-e^{-Kt})$

cent removal of settleable solids in 1969 was 76, in 1967 these ranged from 51-90 percent. These results indicate that the percent removals achieved by the Passaic Valley Sewerage Commissioners' treatment plant are generally below the acceptable efficiency ranges indicated for typical municipal waste treatment facilities.

A comparison of the BOD removal based upon settling rates (gallons per day per square foot) contained in the "Recommended Standards for Sewage Works", 1968 Edition, with the indicated overflow rates of the existing sedimentation basin reported in the 1968 report on Proposed Head End Facilities also suggests that BOD removals during the four studies were lower than might be expected. For example, using an average annual flow of 235 mgd and an overflow rate of 1830 gpd per sq. ft. the BOD removal based on the Recommended Standards should be approximately 20 percent.

Much of the inefficiency of the settling tanks can be attributed to the poorly operated and inadequately sized grit chambers. These chambers, as discussed earlier, allow large quantities of inorganic solids to reach the sedimentation basins. Inorganic materials have continually interfered with the mechanical sludge collection systems. Shear pin failures, flight breakage, grit and grease accumulations and rag interference with chains and overflow weirs have been reported in studies regarding the plant operations made by consultants to Passaic Valley Sewerage Commissioners. These breakdowns create appreciable overload to the operating basins which are handling more flow than designed for.

A comparison of influent characteristics found during the Federal Water Pollution Control Administration surveys of Passaic Valley Sewerage Commissioners with studies of waste treatment facilities handling wastes primarily from residential and commercial service areas indicate the high strength and complexity of the Passaic Valley Sewerage Commissioners wastewater. In the Passaic Valley Sewerage Commissioners' influent, BOD, suspended solids and settleable solids concentrations were generally 50 percent greater and values of COD were two to three times greater than those found in typical domestic collection systems, indicating the effect of the industrial load. The high concentrations of soluble oxygen demanding materials, which are not readily removed by sedimentation, may be another factor in the low BOD removals of the Passaic Valley Sewerage Commissioners' waste treatment facility.

An inadequate maintenance program may also reduce the efficiency of the primary units. During a June, 1969 inspection, it was observed that scum and solids were built up around the discharge weirs of many of the sedimentation basins. Many of the overflow weirs were not properly adjusted and several were completely submerged.

WATER QUALITY STUDIES

Water Movement and Dispersion

New York Harbor, which is the receiving body for the inadequately treated wastewaters of the Passaic Valley Sewerage Commissioners, forms part of an hydraulically complex tidal water system with interconnections between Raritan Bay through the Arthur Kill-Kill Van Kull, Long Island Sound through the East River, the Atlantic Ocean through the Narrows and the Hudson River. An examination of the movement of water through the Harbor indicates the probable paths of flow of the wastewater discharge at Robbins Reef. Dye studies, carried out in September, 1964[16/] and August, 1969, provided some information regarding water movement and dispersion characteristics in the Harbor.

In September, 1964, 1,000 pounds of Rhodamine B dye were released at high water slack over the Passaic Valley Waste Treatment Plant Outfall near Robbins Reef. This dye release showed the following results:

(1) Pollutants introduced at Robbins Reef affect a broad area of the Lower Bay of New York Harbor, and are found on the Staten Island shore from Midland Beach to the Narrows within 6 hours of release;

(2) Within 32 hours of release, such material affects a large area of Raritan Bay and is found on the Staten Island shore from the Narrows to Great Kills, as well as on the Coney Island shore of Brooklyn;

(3) On an ebb current there was little lateral mixing across the Narrows, but lateral mixing does occur on the first flood current following release;

(4) Pollutants moving from the release point on the first ebb pass along the western edge of the channel and the Staten Island shore before passing through the Narrows.

The limits of the 1964 dye mass at various stages of time following release are shown in Figure 2.

On August 14, 1969, 1,600 pounds of dye were placed in the Passaic Valley Sewerage Commissioners Outfall Works and discharged to the Upper Bay at Robbins Reef at high water slack. The results, which confirm the dispersion pattern found during the 1964 study are:

(1) At high water slack, the dye diffuses across the Harbor channel and slightly north and south of the dispersal field;

(2) The bulk of the dye remains below the water surface and does not initially disperse rapidly;

(3) Within three hours of release through the dispersal field, dye was carried outside the Narrows and was well dispersed across the main channel;

(4) Within six hours of the initial release, dye reached the South Beach, Staten Island and the Coney Island bathing beaches in Brooklyn.

The results of the two dye studies indicate that pollution materials, such as bacteria discharged at Robbins Reef from the Passaic Valley Sewerage Commissioners' waste treatment facilities, can reach the recreational bathing beaches of Staten Island and Coney Island within six hours after release. Pathogenic organisms, which are likely to be present in an unchlorinated wastewater discharge, are a definite health hazard to persons utilizing the waters of Lower Bay for recreational purposes.

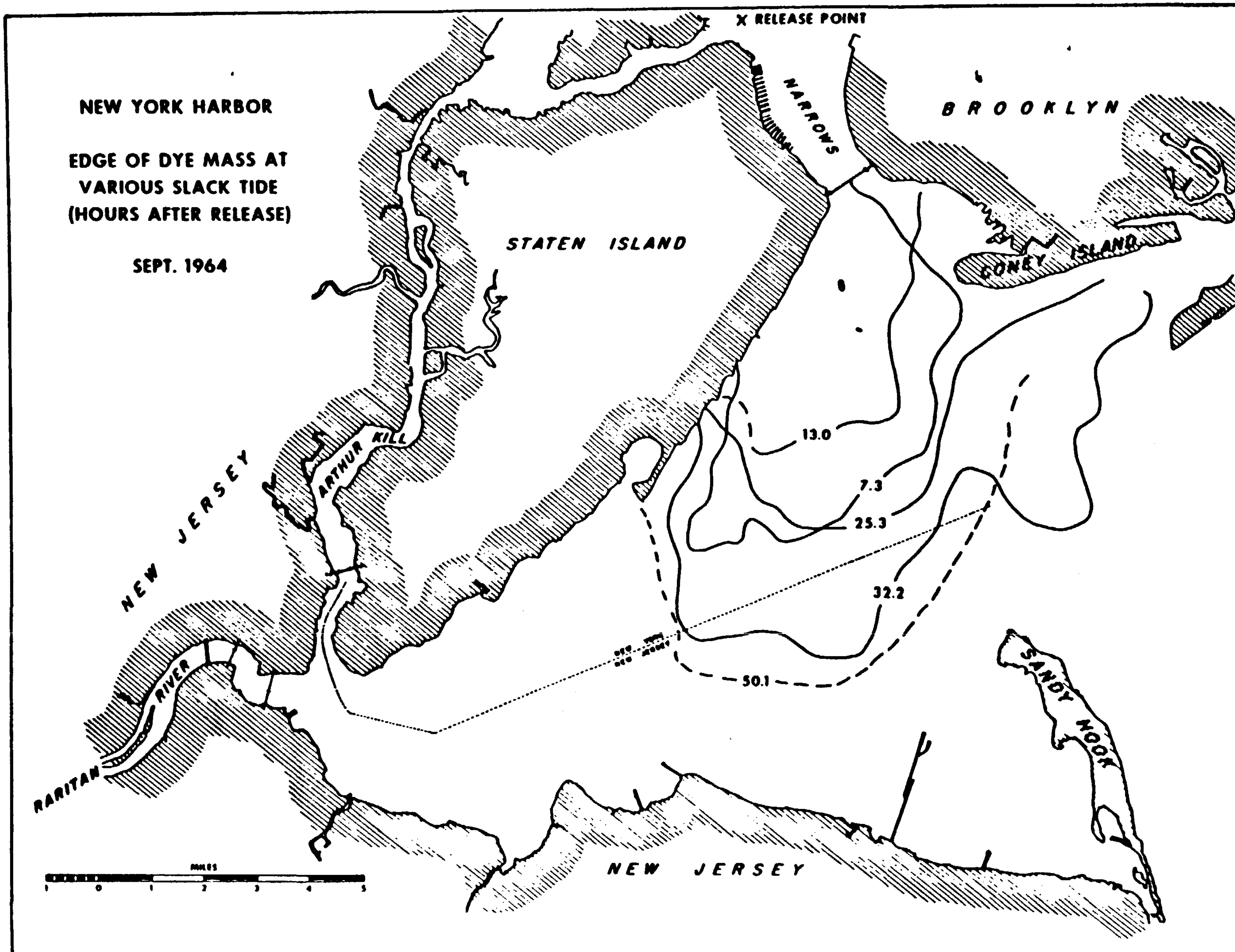

NEW YORK HARBOR
EDGE OF DYE MASS AT
VARIOUS SLACK TIDE
(HOURS AFTER RELEASE)
SEPT. 1964
X RELEASE POINT
NARROWS
BROOKLYN
STATEN ISLAND
CONEY ISLAND
ARTHUR KILL
NEW JERSEY
RARITAN RIVER
13.0
7.3
25.3
32.2
50.1
SANDY HOOK
NEW JERSEY
MILES
1
0
1
2
3
4
5

Figure 2

Water Quality - New York Harbor

The waters of the Upper Bay of New York Harbor receive the discharges of raw and treated wastewaters from sources in New York and New Jersey, including the Passaic Valley Sewerage Commissioners. These wastes affect the quality of water throughout the Harbor. Details regarding these discharges have been presented in previous conference reports. Wastewater discharged from Passaic Valley Sewerage Commissioners at Robbins Reef account for about one-fifth of the total estimated flow and nearly one-half of the total organic load entering these waters daily. The data also show that present treatment reduces the total organic load from all New York sources by approximately 56 percent; from all New Jersey sources by approximately 35 percent; and from the Passaic Valley Sewerage Commissioners by approximately 10 percent. Most of the municipalities and industries in the conference area except the Passaic Valley Sewerage Commissioners are moving ahead to meet the conference recommendations.

Water quality in Upper Bay of New York Harbor has been investigated throughout the years by the States of New Jersey and New York, the Federal Water Pollution Control Administration, the Interstate Sanitation Commission and New York City. These studies show that the waters of the Harbor have been and are degraded. Dissolved oxygen levels fall to values less than 3.0 mg/l and mean total coliform densities are in the tens of thousands. Bi-monthly surveillance surveys of New York Harbor by the Federal Water Pollution Control Administration show that water quality for these waters does not meet the approved water quality standards for either New York or New Jersey

Data for dissolved oxygen for the period January through December 1968 obtained from three automatic monitoring stations operated by the Federal Water Pollution Control Administration illustrate the degraded quality of water in the Harbor. These data are summarized below.

Station	% Time Less Than 3 mg/l	% Time Less Than 4 mg/l
U. S. Gypsum Kill Van Kull New Brighton, S.I., N.Y.	54	60
Outerbridge Crossing Arthur Kill	39	49
Quarantine Station Narrows Rosebank, S.I., N.Y.	25	38

A 24-hour study of the Upper Bay of New York Harbor was conducted on August 19-20, 1969 to determine the quality of these waters in relation to the approved standards. Six (6) stations located around the Passaic Valley Sewerage Commissioner' dispersal field were sampled, 5 feet from the surface and 5 feet from the bottom, every one-and-one half (1½) hours. Parameters analyzed included temperature, dissolved oxygen, pH, conductivity and total and fecal coliform.

The results of the survey are presented in Appendix D. Figures 3, 4 and 5 show the averages for dissolved oxygen (percent saturation) and geometric means for total and fecal coliform concentrations for the surface stations. Figures 6, 7, and 8 show the profiles for deep stations.

The survey results show that 84 percent of all the samples examined contained dissolved oxygen levels less than the 50 percent saturation established by the water quality standards of New York and New Jersey. In the majority of cases, values were below the minimum of 3.0 mg/l established by the New York standards.

Average dissolved oxygen levels in both surface and deep samples fell below the 50 percent saturation limit. The lowest average value of 31 (surface) and 39 (deep) percent saturation was found at the most northern station (Station 18-closest to Battery) while the highest of 39 and 47 percent saturation occurred at the most southern station (Station 21-closest to the Narrows).

Variation of dissolved oxygen, as shown by the typical percent saturation profile for station 20 (Figure 9), is primarily attributed to tidal influences. Values for percent saturation at deep stations reached high levels during high tidal stages and low levels during low tidal stages. At each surface station, the profile indicates that dissolved oxygen during evening hours did not increase with the high tide and generally remained at the lower levels. Respiration by phytoplankton may account for this lack of improved oxygen regardless of tidal stage, during evening hours.

Total coliform densities, which also appear to be affected by tidal conditions, ranged from 31,000 to over 1,000,000 per 100 ml for surface stations, and from 7,300 to 4,000,000 per 100 ml for deep stations. The highest counts during the survey period were found in deep water at station 18, the most northern station; at station 19, just north of the dispersal field; and at station 20, just south of the dispersal field. An analysis based on geometric mean total coliform densities shows higher mean values for the surface stations occurring at Kill Van Kull, station 22, and just north (Station 19) and south (Station 20) of the Passaic Valley Sewerage Commissioners' effluent dispersal field; for the deep stations the higher values were at the northern most station (Station 18) and just north (Station 19) of the dispersal field.

The fecal coliform densities exhibited the same general pattern as total coliform. Fecal coliform counts varied from 1,300 to 130,000 per 100 ml and 1,000 to over 760,000 per 100 ml, respectively, for surface and deep stations. The geometric mean fecal coliform levels show that the higher mean levels at the surface occurred at Kill Van Kull (Station 22) and at the surface and bottom just north of the dispersal field (Station 19). These high fecal coliform levels strongly suggest gross contamination of the majority of the waters in New York Harbor by the discharge of human wastes.

Two other 24-hour water quality studies of the Harbor were conducted on July 10-11, and 16-17, 1969. Seventeen stations were sampled shallow and deep every four hours for the 24-hour period. These stations centered around the Passaic Valley Sewerage Commissioners' dispersal field and were arranged in three concentric circles. Data collected during these surveys indicated similar water quality conditions as those found during the August 19-20, 1969 survey. In nearly all cases dissolved oxygen was less than 50 percent saturation. Total coliform levels ranged from 6,000 to 2,000,000 organisms per 100 ml and fecal levels ranged from 400 to 1,000,000 per 100 ml. Again, variations in parameters were observed to coincide with tidal conditions. Highest values for dissolved oxygen and

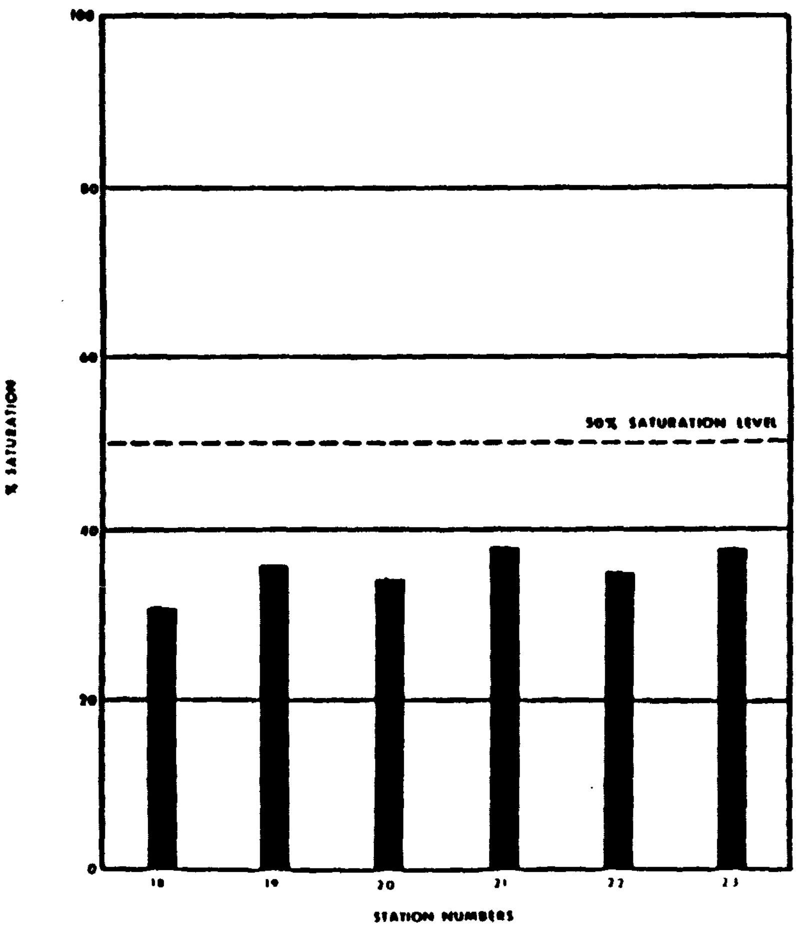
DISSOLVED OXYGEN

AVERAGE VALUES

UPPER BAY-NEW YORK HARBOR

SURFACE STATIONS

19 & 20 AUGUST 1969



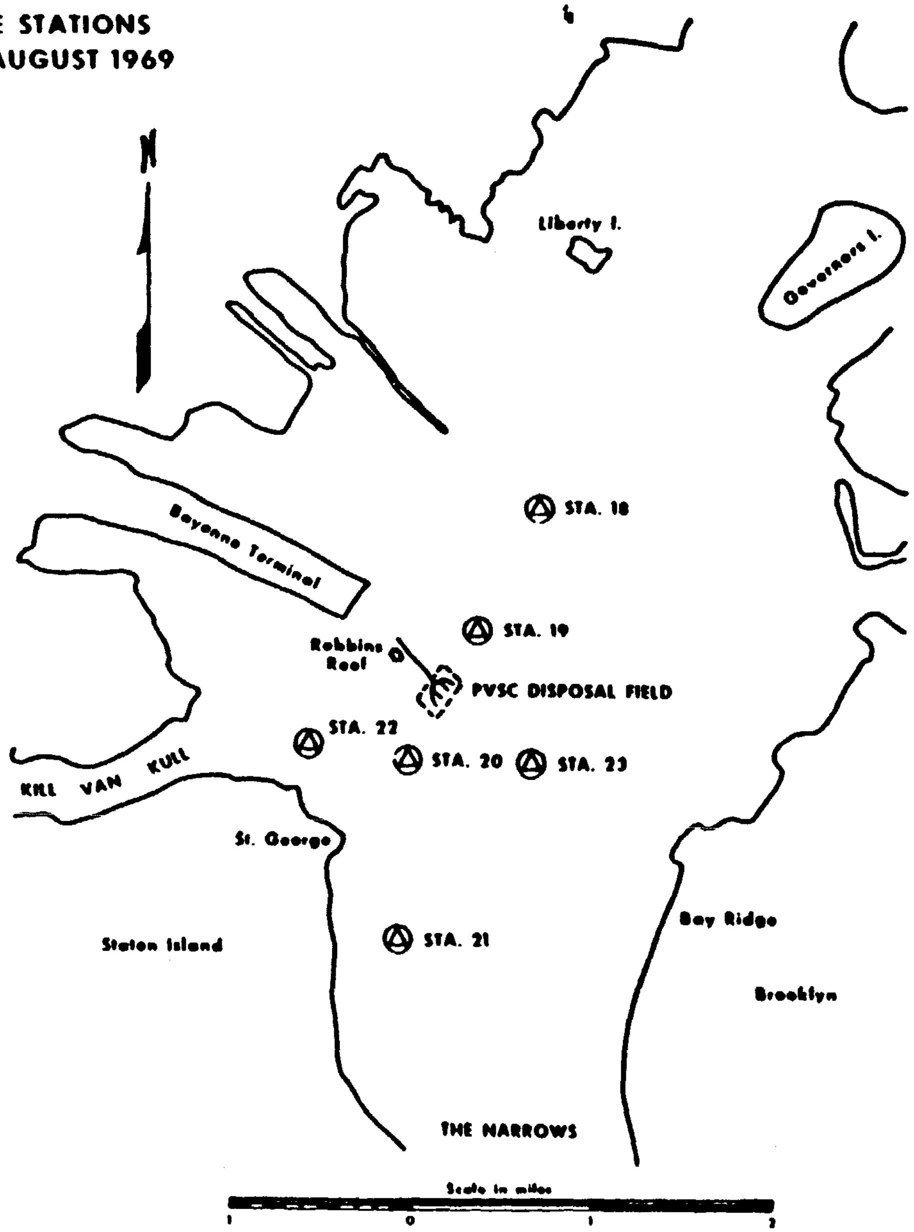
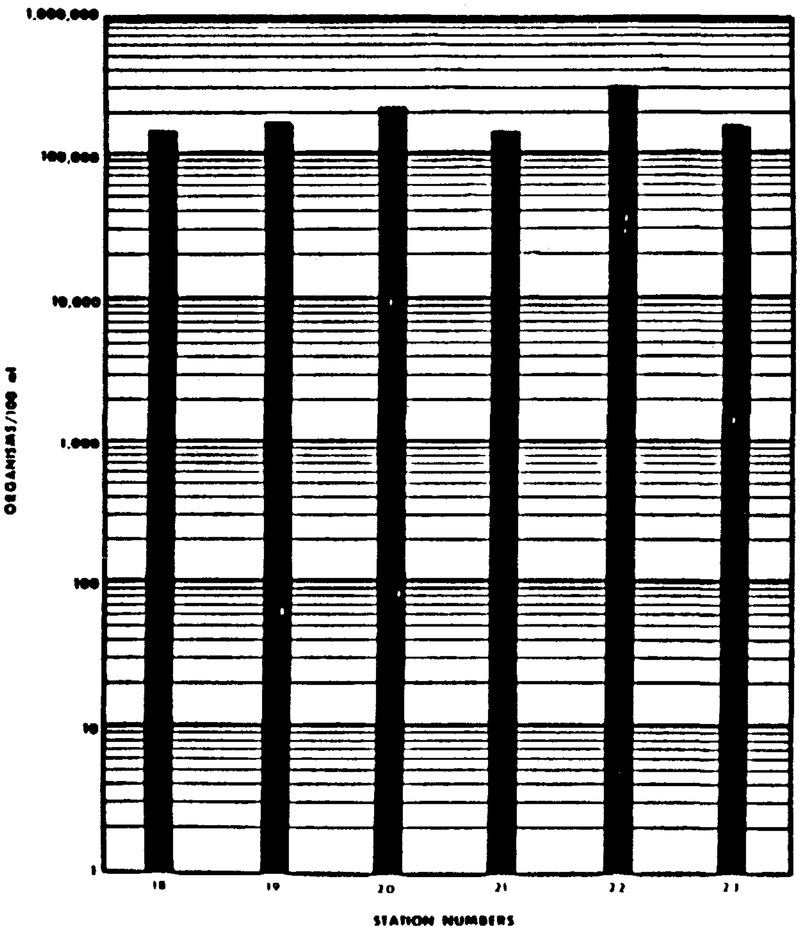


Figure 3

TOTAL COLIFORM
GEOMETRIC MEAN
UPPER BAY-NEW YORK HARBOR
SURFACE STATIONS
19 & 20 AUGUST 1969



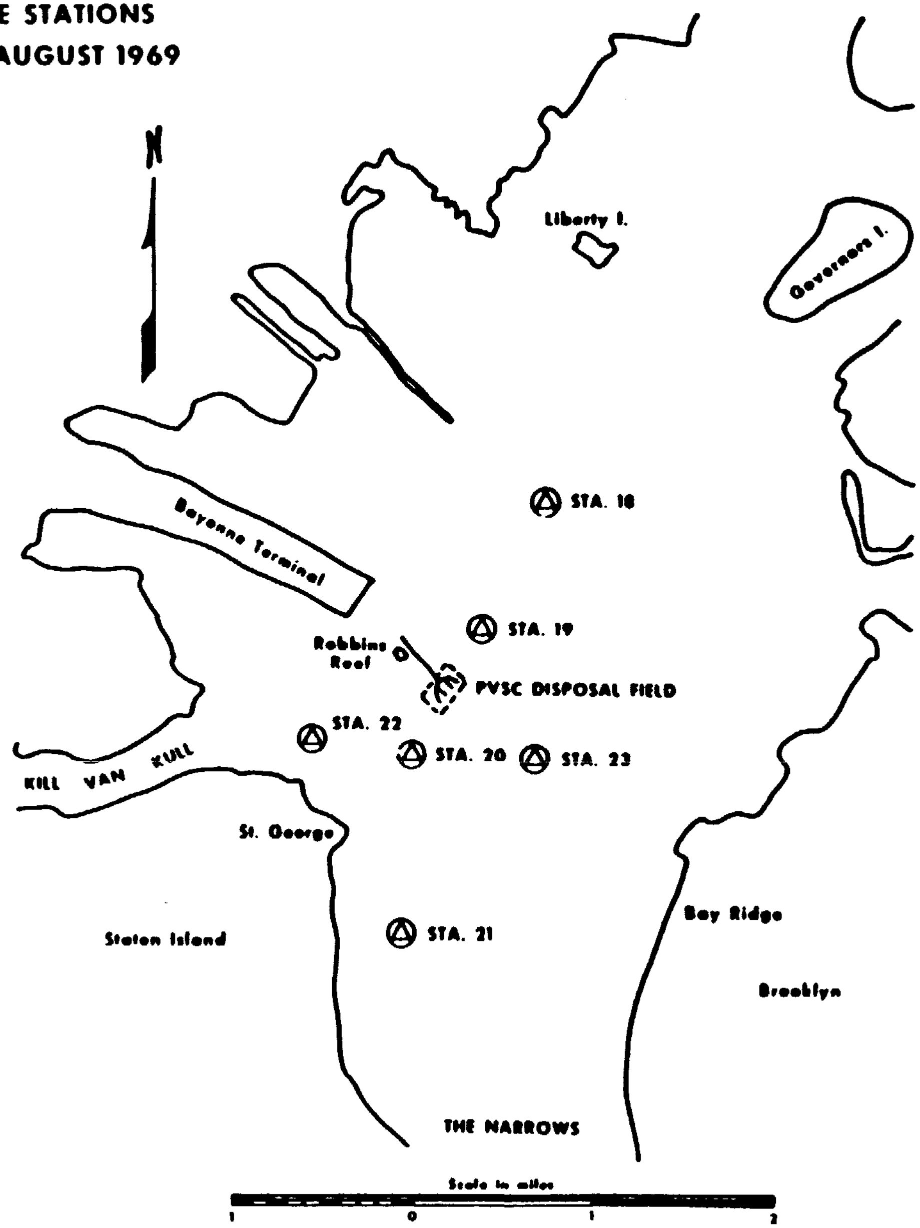


Figure 4

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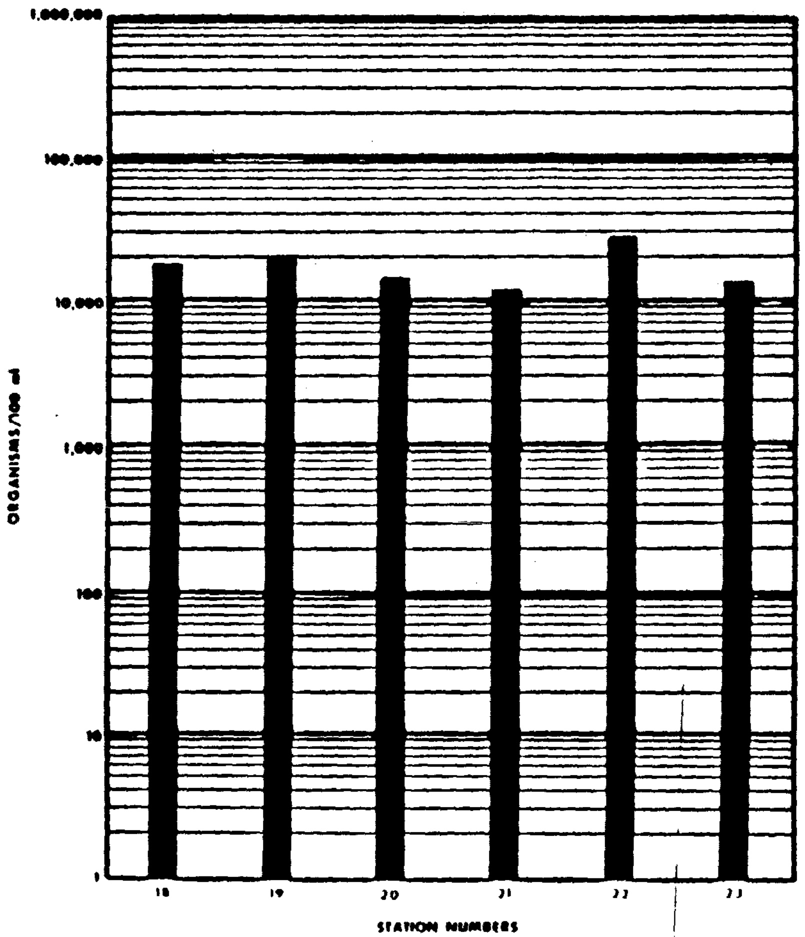
FECAL COLIFORM

GEOMETRIC MEAN
UPPER BAY-NEW YORK HARBOR
SURFACE STATIONS
19 & 20 AUGUST 1969



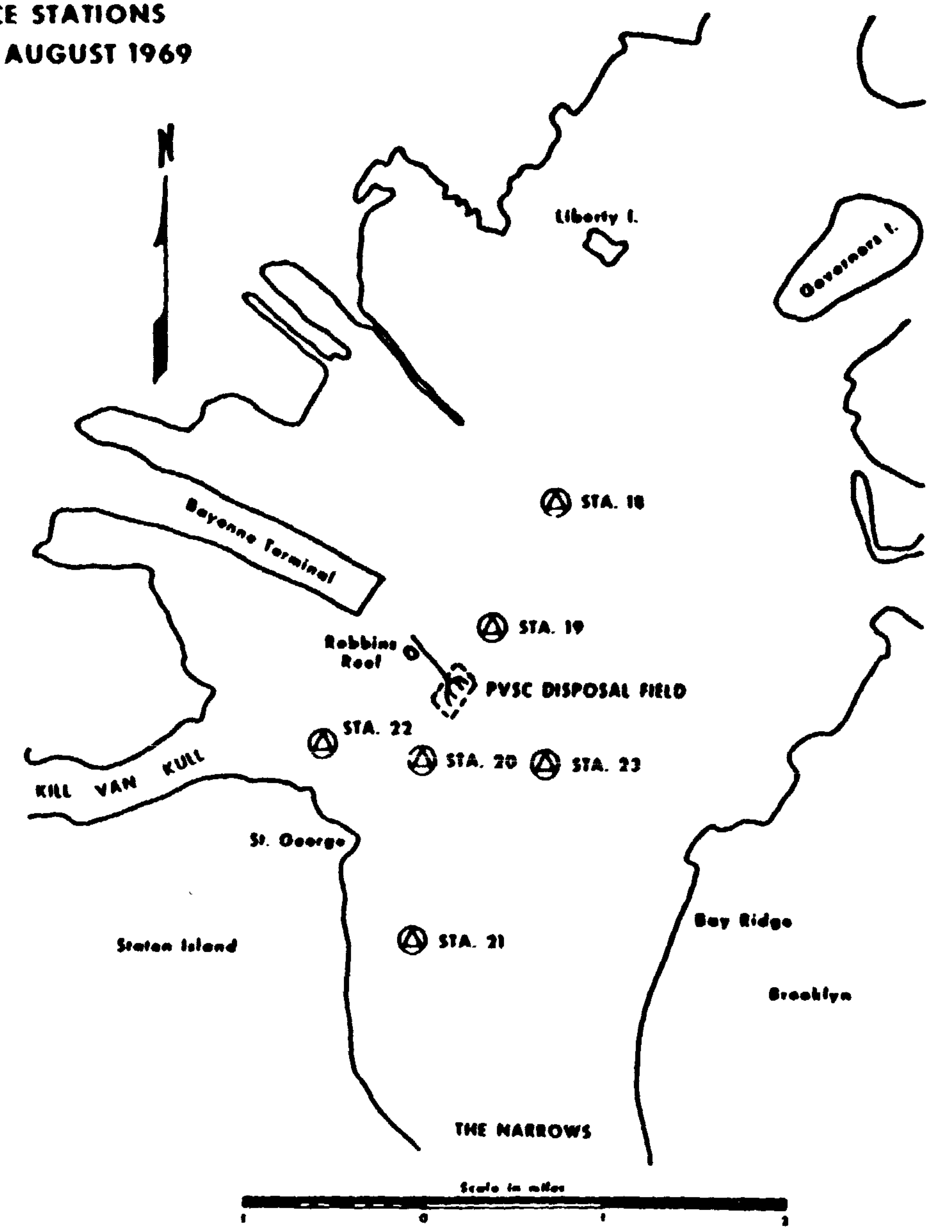
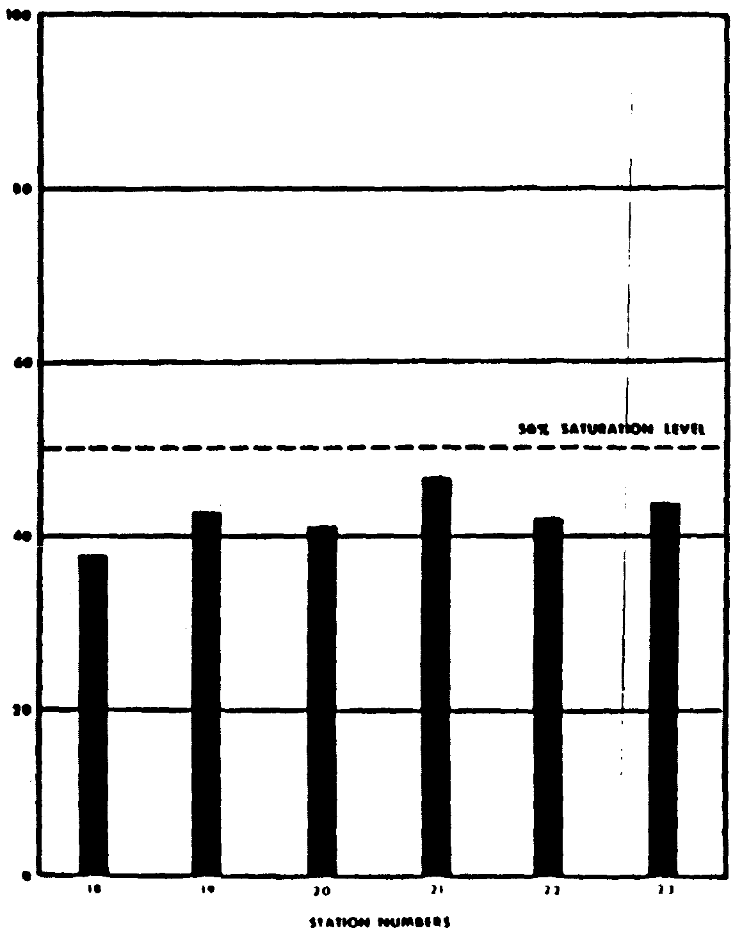


Figure 5

DISSOLVED OXYGEN

AVERAGE VALUES
UPPER BAY-NEW YORK HARBOR
DEEP STATIONS
19 & 20 AUGUST 1969



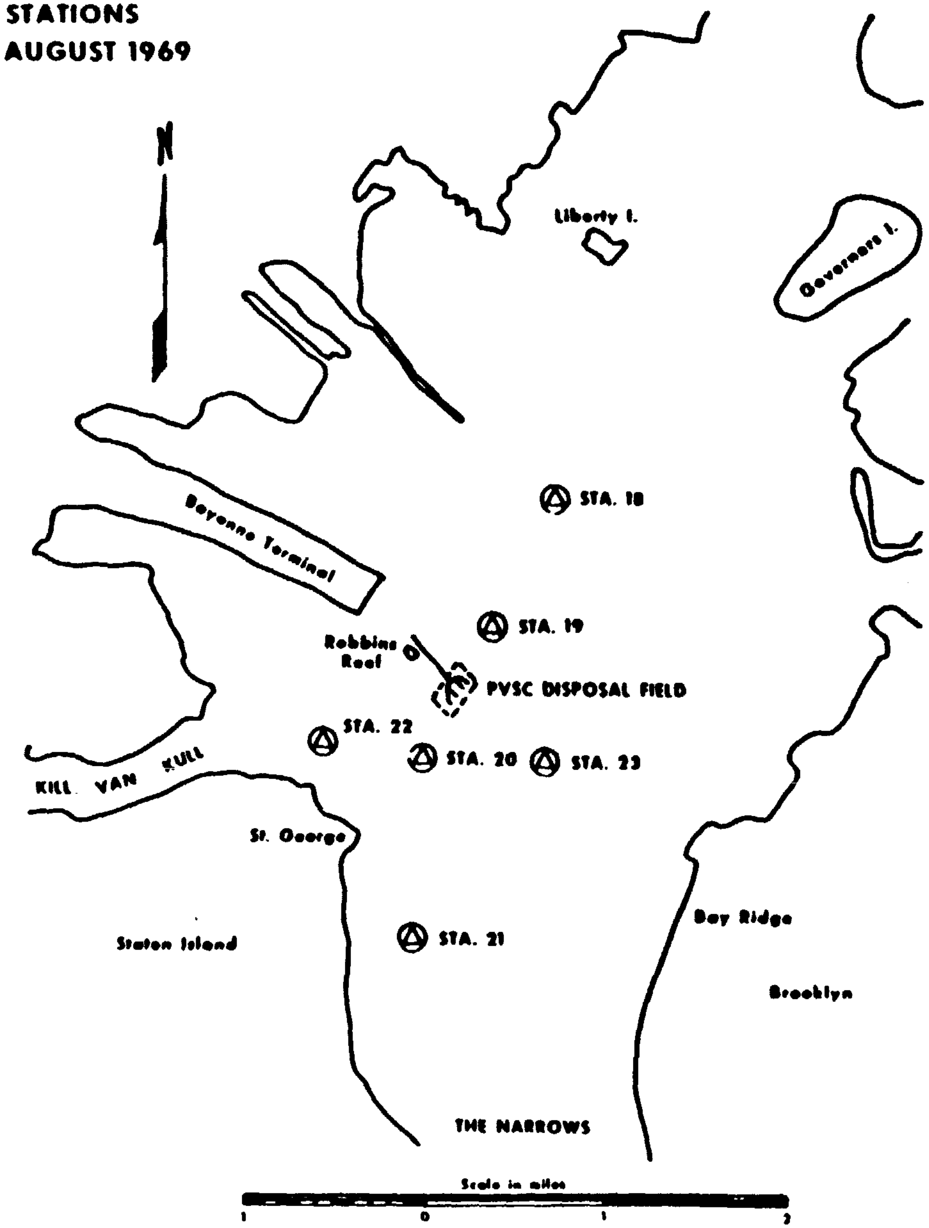
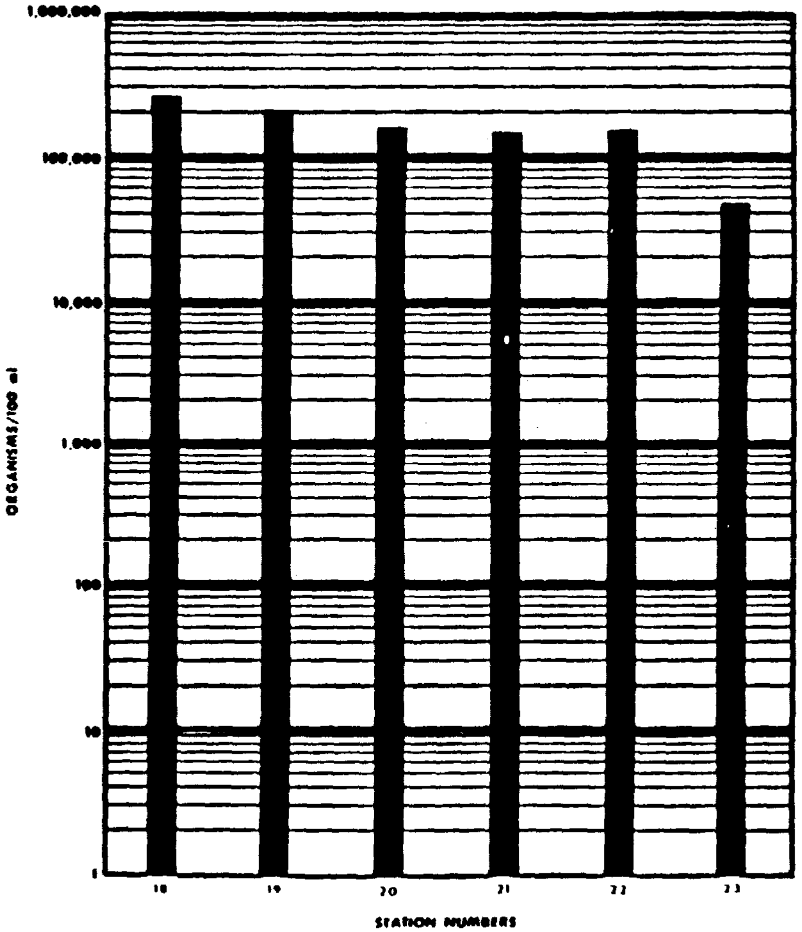


Figure 6

TOTAL COLIFORM
GEOMETRIC MEAN
UPPER BAY-NEW YORK HARBOR
DEEP STATIONS
19 & 20 AUGUST 1969



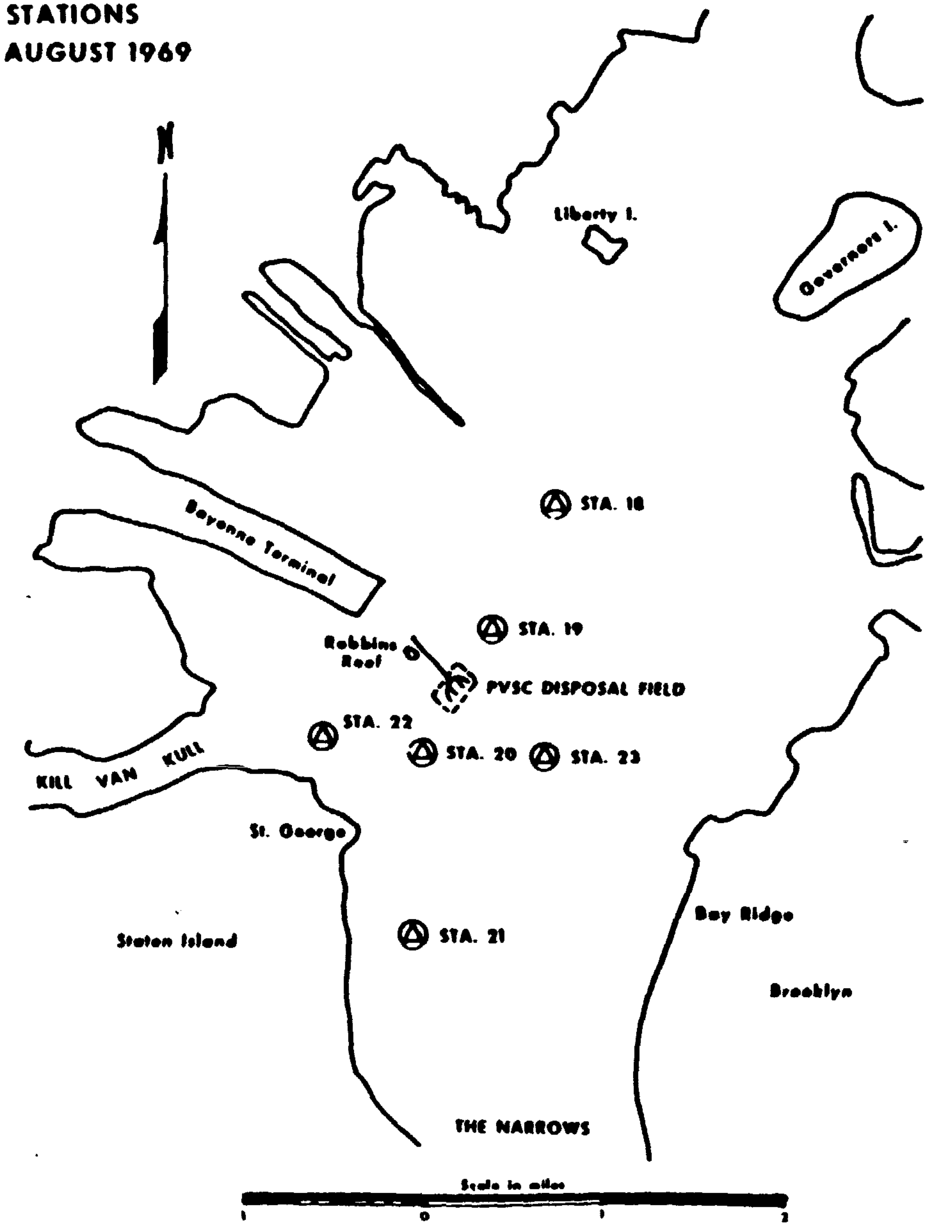
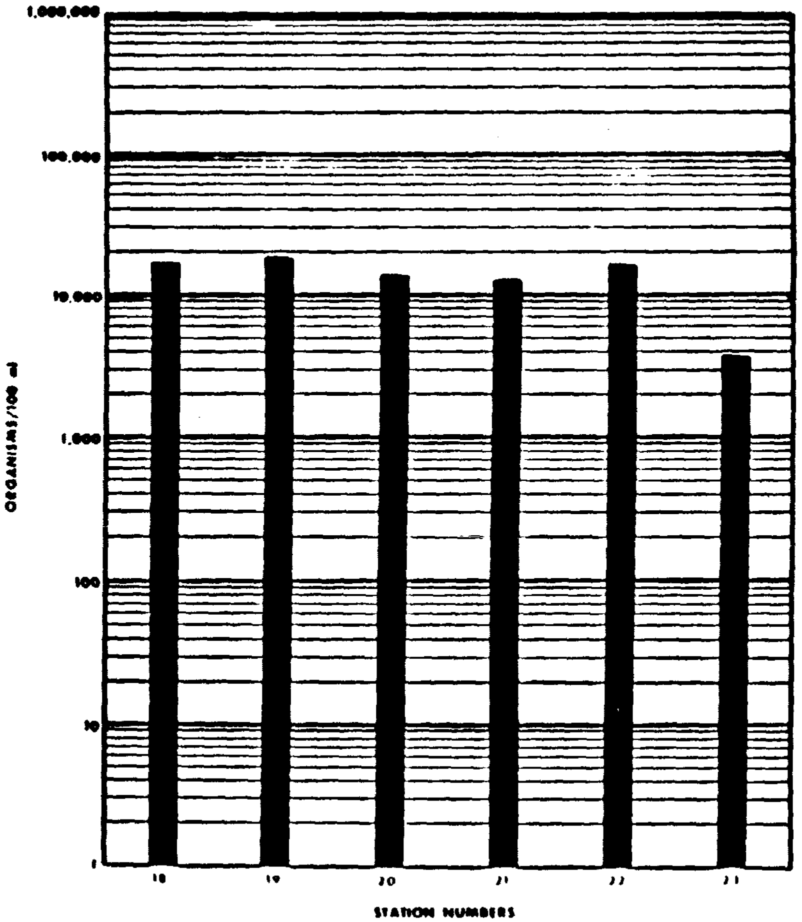


Figure 7

FECAL COLIFORM
GEOMETRIC MEAN
UPPER BAY-NEW YORK HARBOR
DEEP STATIONS
19 & 20 AUGUST 1969



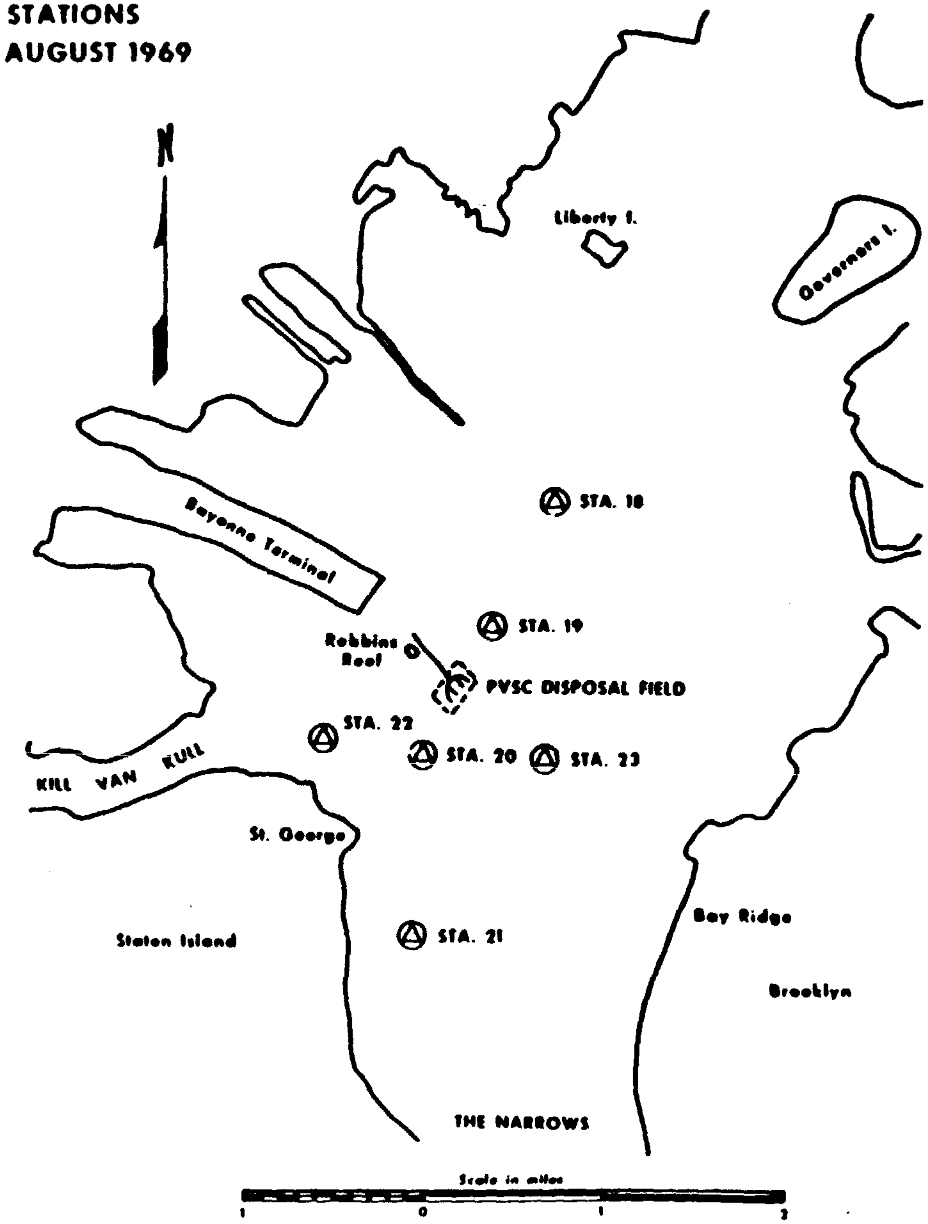


Figure 8

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DISSOLVED OXYGEN
UPPER BAY-NEW YORK HARBOR
19 & 20 AUGUST, 1969
STATION 20

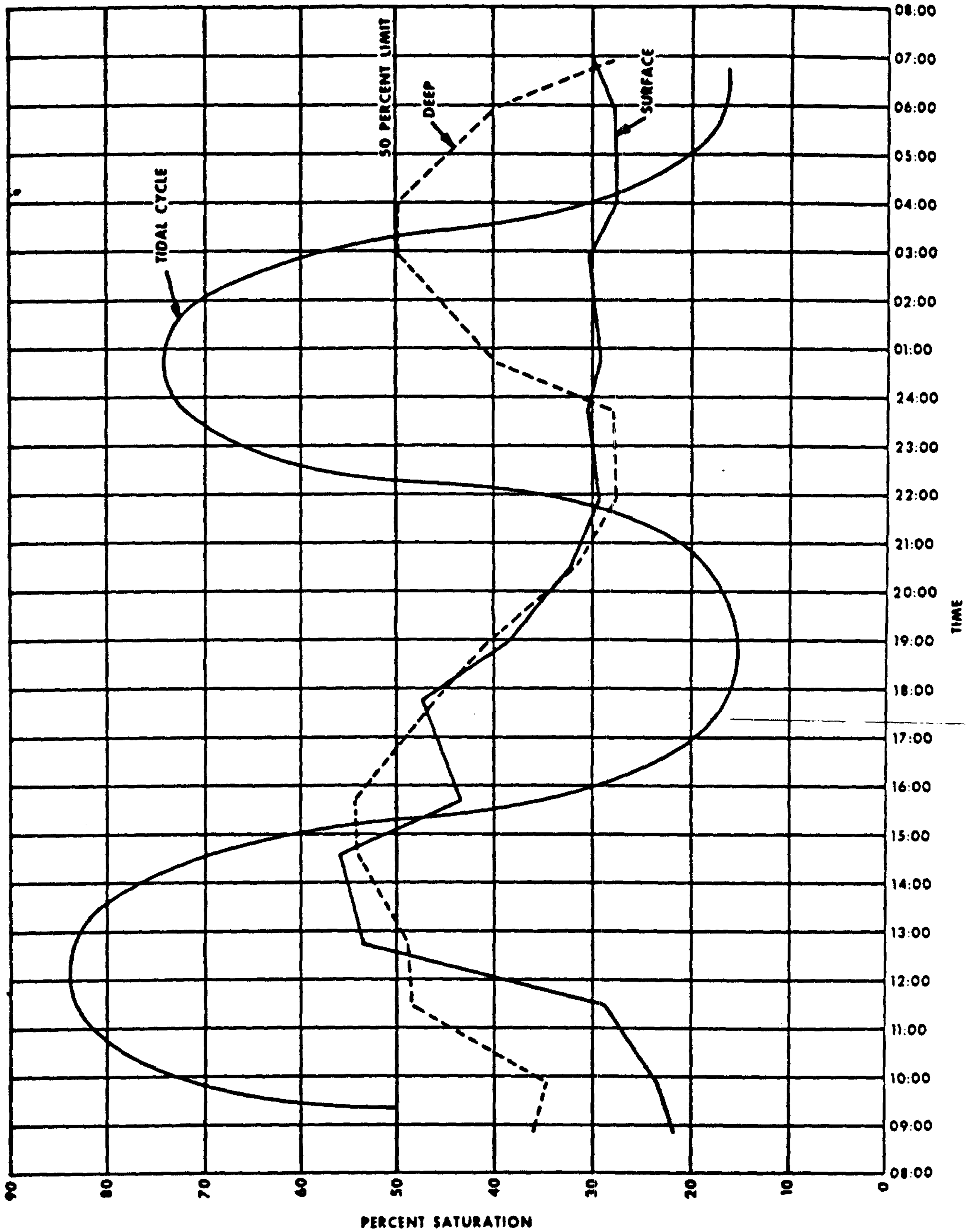

Figure 9

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lower densities of coliform organisms were found at the station nearest the Narrows. Poorest quality conditions existed at the most northern station closest to the Battery in Manhattan.

Bacteriological Studies

Coliform Bacteria

Bacteriological examinations were concurrently conducted in the waters adjacent to the Passaic Valley Sewerage Commissioners' dispersal field and the effluent of the waste treatment facility. The purpose of the simultaneous sampling and analysis was to demonstrate the presence of high densities of intestinal bacteria in the plant effluent and in the waters surrounding the dispersal field.

Since the time required for transit of material discharged at Robbins Reef to South Beach and Midland Beach on Staten Island is approximately six hours, studies were conducted to obtain data on the survival characteristics of the coliform bacteria during a six hour exposure period. These studies were conducted at four stations located at Robbins Reef, Buoy 22 and at Quarantine Station in the Narrows; and at South Beach on Staten Island. Details of this study are included in Appendix E. Results indicated that a minimum of 20,000 organisms per 100 ml survived the six hour exposure for passage of sewage from the outfall at Robbins Reef to South Beach and Midland Beach on Staten Island. From 58 to 95 percent of the coliforms at all stations survived the six hour exposure period and exceeded the New York State coliform standard for bathing beach water.

Pathogenic Bacteria

The presence of high levels of fecal coliform bacteria in the Passaic Valley Sewerage Commissioners' waste effluent and the receiving water are indicative of dangerous fecal contamination from warm-blooded animals. Samples of the effluent contained enteric pathogenic bacteria. Four different *Salmonella* serotypes were isolated. Samples at the sewage dispersal field at Robbins Reef yielded five *Salmonella* serotypes. The occurrence of such pathogens, which cause gastroenteritis in man, pose an initial hazard to water users in the Upper Bay.

Although it is known that seawater manifests a bactericidal effect on intestinal bacteria, it cannot be relied upon to completely dispose of pathogens emanating from inadequately treated sewage. Previous studies conducted in Raritan Bay (1967)[16/] indicate that the salmonellae may persist in estuary water for various periods of time. Studies were undertaken to demonstrate that these enteric pathogenic bacteria may survive the six hour exposure period required for travel from the Robbins Reef dispersal area to beaches on Staten Island. Water was collected at the dispersal area, placed in sterile dialysis tubing and immersed for six hours in the Upper Bay water. The dialyzer tubing used is permeable to water and allows the passage of low molecular weight compounds in aqueous solution, while retaining materials with molecular weights of 12,000 and higher, such as proteins. Bacteria, as a result, will be retained by the membrane; however, viruses and bacteriophage will be allowed passage along with low molecular weight materials in aqueous solution. Details of this study are included in Appendix E. Salmonellae were detected in the outfall receiving water prior to in situ immersion of the dialysis chambers. After six hours exposure in the Upper Bay receiving water, salmonellae could still be isolated from the sample water. The fact that a similar serotype in addition to other serotypes could still be isolated after six hours exposure to the bay water establishes a potential effect on the beaches below the Narrows. Reliability of these data are reinforced by the routine isolations of salmonellae made in previous studies at South Beach and Midland Beach on Staten Island and by the isolation of *S. enteritidis* er. san diego at South Beach on September 4, 1969.

The significance of the presence of these salmonellae in the effluent, receiving water and at South Beach can be assessed in light of the *Salmonella Surveillance Reports* of the U. S. Public Health Service (From January to July 1969). Two of the salmonella serotypes isolated from the Passaic Valley Sewerage Commissioners' effluent and two serotypes isolated at the outfall receiving water are among the top ten serotypes infecting man in the United States. They are *S. typhimurium*, *S. heidelberg*, *S. thompson* and *S. derby* which rank one, three, six and ten, respectively.

Water Quality - Passaic River

A survey was conducted on June 5, 1969 by the Federal Water Pollution Control Administration to determine whether water quality in the Passaic River meets the approved water quality standards. The study area extended from the confluence of Passaic River with Newark Bay to the Route 46 Bridge near Little Falls. This stretch is within the service area of the Passaic Valley Sewerage Commissioners. The State of New Jersey has classified these 32 miles of river as: Class FW-2 above Little Falls; Class FW-3 from Little Falls to Dundee Dam; and Class TW-3 in the tidal section from Dundee Dam to the Newark Bay confluence. The water quality criteria to meet these classifications are contained in Appendix B.

Water samples were collected at 15 stations of which 10 were located in the tidal portion below Dundee Dam. Table 4 describes each station and its river mileage from Newark Bay. Parameters measured at each station were: temperature, dissolved oxygen (DO), pH, total organic carbon (TOC), and total and fecal coliform. Table 5 summarizes the results of the survey.

Figure 10 presents the DO profile of the Passaic River from near Little Falls to Newark Bay. Dissolved oxygen in the fresh water portion was generally above 6.0 mg/l, reaching a maximum of 9.8 mg/l at Dundee Dam. In the tidal section dissolved oxygen showed a significant decrease, in most instances to levels below the minimum 2.5 mg/l established by the standards. A complete depletion of DO occurred at mile 4.7 in the vicinity of Harrison. Similar DO conditions were observed during a July, 1968 survey, when a low of 0.2 mg/l occurred at mile 1.1 near Kearny Point.

Total coliform densities ranged from 9,700 organisms per 100 ml above the Passaic Valley Sewerage Commissioners' service area near Two Bridges to 500,000 organisms per 100 ml in the tidal section near Newark Bay. Figure 11 presents the profile for total coliform levels for the area studied. Total coliform levels in all samples in the fresh water portion exceeded the 1,000 organisms per 100 ml monthly average suggested by the standards. Levels increased from 9,700 per 100 ml near Little Falls to

68,000 per 100 ml about 2.5 miles above Dundee Dam near East Paterson. In the tidal section, densities showed an increasing trend from about 20,000 per 100 ml just below Dundee Dam to 500,000 per 100 ml at the confluence of the Passaic with Newark Bay. Levels dropped to about 17,000 per 100 ml in the Bay. The results of the 1968 survey showed a similar distribution of total coliform densities with an increase in levels from 44,000 per 100 ml below Dundee Dam to 160,000 per 100 ml near Harrison.

Fecal coliform densities, which represent an indication of recent contamination with the feces of warm-blooded animals such as man, were found to be high throughout the study area. Figure 12 shows the fecal coliform profile found during the June 5, 1969 survey. Fecal coliform levels were less than 1,000 organisms per 100 ml upstream of the Passaic Valley Sewerage Commissioners' service area but increased sharply to levels in excess of 5,000 per 100 ml within the service area. Fecal coliform levels in the tidal section followed the same upward trend as for total coliform, increasing from 4,000 per 100 ml below Dundee Dam to 68,000 at the confluence with Newark Bay. In Newark Bay, fecal coliform counts dropped to 2,100 per 100 ml.

During the 1968 survey, fecal coliform levels at all stations were high, particularly in the tidal section. Below Dundee Dam, the fecal coliform count increased from 5,000 to 24,000 per 100 ml near Harrison. Levels decreased to 3,900 at Newark Bay.

Although the water quality standards contain no criteria for fecal coliform, the survey data indicate that the Passaic River throughout the 32 miles of study is contaminated by wastes from warm-blooded animals. This contamination is a potential health hazard for persons who come into contact with these waters.

TABLE 4

SAMPLING STATIONS
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
SURVEY OF PASSAIC RIVER
JUNE 5, 1969

Station No.	Mileage	Station Description
TW-0	0.0	In channel off buoy N-24 (Newark Bay)
TW-1	1.1	South of Central R.R. of N.J. Bridge
TW-2	2.8	North of Overhead Power Cable & South of D.L. & W.R.R.
TW-3	4.7	Jackson St. Bridge
TW-4	6.3	Clay St. Bridge
TW-5	8.8	Rutgers St. Bridge
TW-5A	10.7	Kingsland Ave. Bridge
TW-6	13.2	Union Ave. Bridge
TW-7	15.2	Eighth St. Bridge
TW-8	17.1	Below Dundee Dam at Outwater Lane Bridge
FW-1	17.5	Above Dundee Dam
TW-2	20.2	Route 4 Bridge
FW-2A	23.7	6th Ave. Bridge (Paterson)
FW-3	27.0	Hillary St. Bridge
FW-4	32.4	Route 46 Bridge (Little Falls

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TABLE 5

DATA, FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
SURVEY OF PASSAIC RIVER
JUNE 5, 1969

Station	Water Temp. °C	pH Std. Units	DO mg/l	TOC 1/ mg/l	Total Coliform Org./100 ml	Fecal Coliform Org./100 ml
TW-0	21.8	7.3	1.4	12	17,000	2,100
TW-1	22.2	7.1	1.0	10	500,000	68,000
Tw-2	24.5	7.2	2.4	9	400,000	40,000
TW-3	23.0	7.2	0.0	14	340,000	52,000
TW-4	23.0	7.3	0.8	13	300,000	38,000
TW-5	23.0	7.3	1.3	13	42,000	5,100
TW-5A	22.1	7.4	2.7	14	50,000	7,100
TW-6	24.0	7.6	6.7	16	21,000	5,700
TW-7	21.5	7.6	2.7	14	26,000	2,100
TW-8	21.5	7.4	8.2	15	21,000	4,000
FW-1	22.0	7.2	9.8	15	14,000	3,800
FW-2	21.0	7.4	6.3	16	68,000	5,800
FW-2A	22.0	7.3	8.6	14	40,000	4,700
FW-3	21.5	6.8	6.2	21	15,000	440
FW-4	21.0	6.8	5.8	12	9,700	640

1/ TOC: Total Organic Carbon

DISSOLVED OXYGEN
PASSAIC RIVER PROFILE
NEWARK BAY TO LITTLE FALLS
5 JUNE 1969

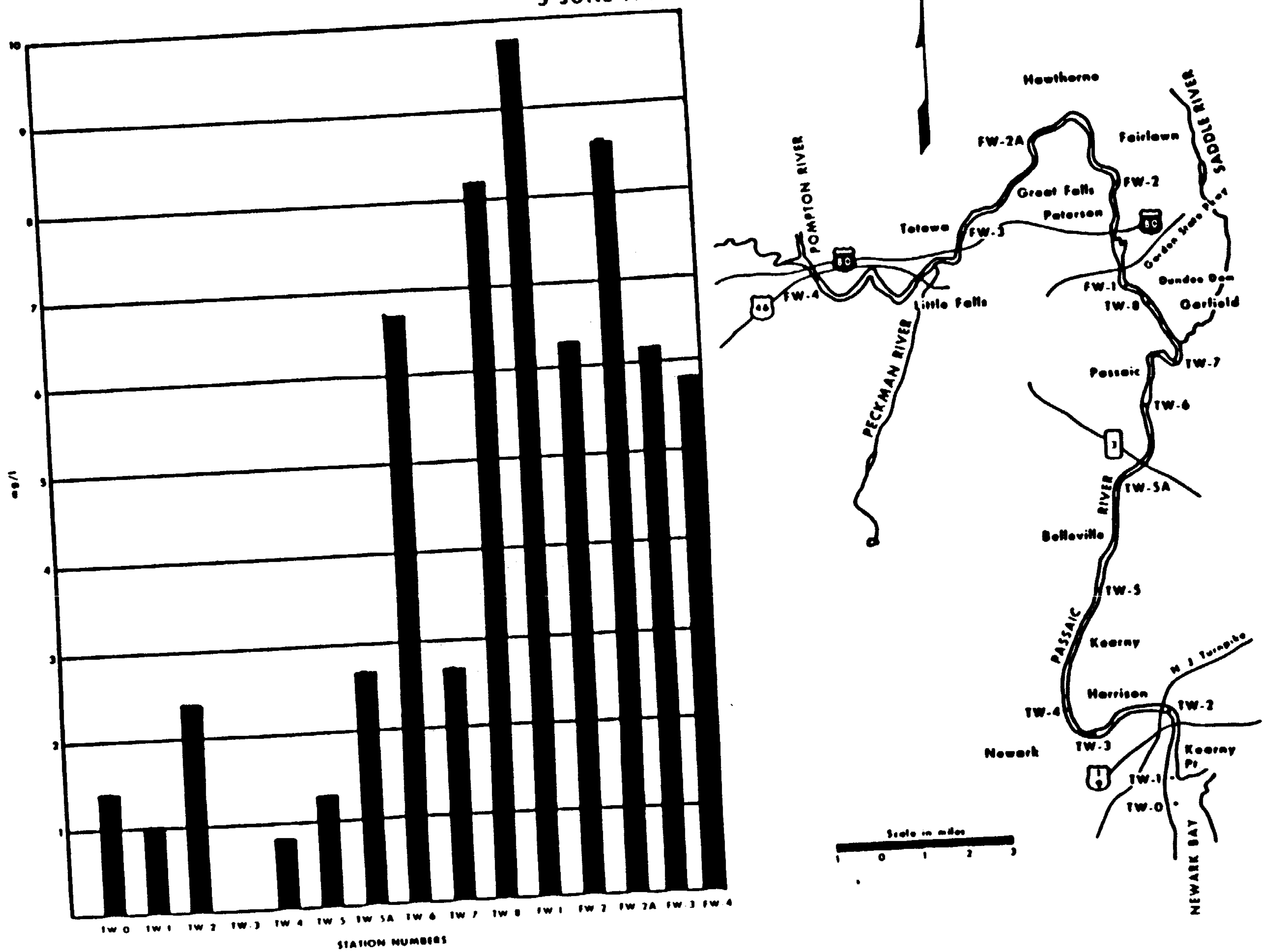

Figure 10

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TOTAL COLIFORM
PASSAIC RIVER PROFILE
NEWARK BAY TO LITTLE FALLS
5 JUNE 1969

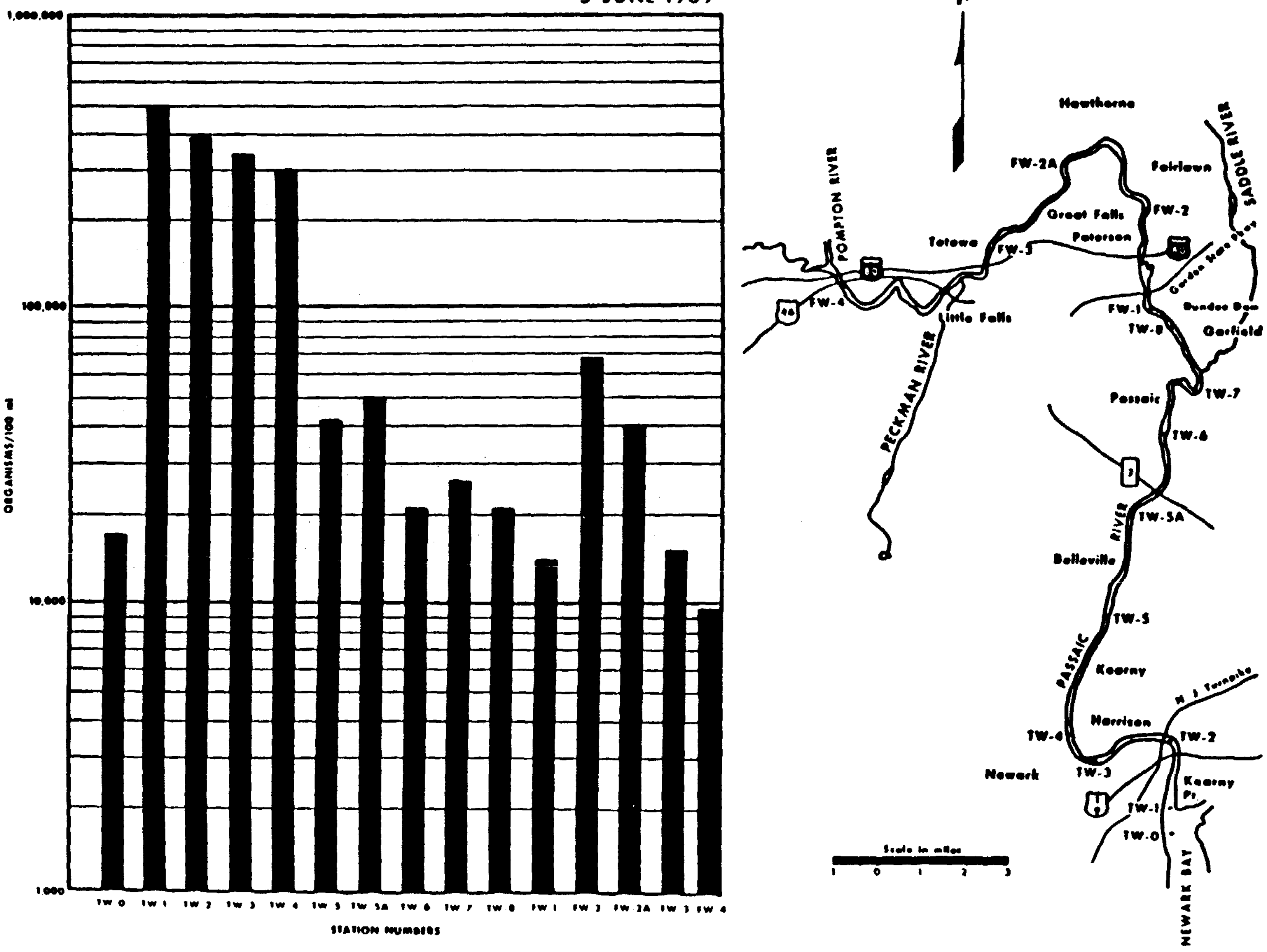
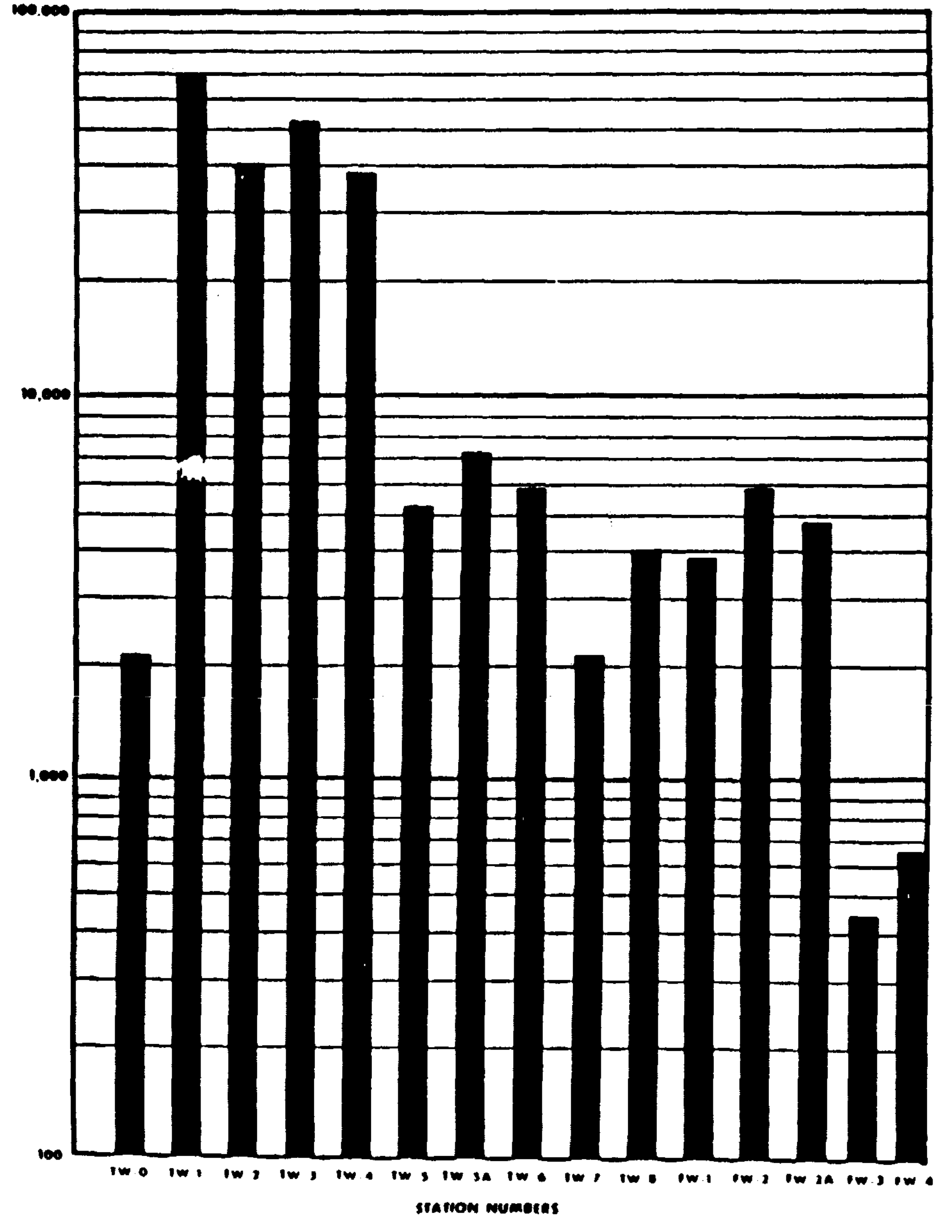


Figure 11

FECAL COLIFORM

PASSAIC RIVER PROFILE
NEWARK BAY TO LITTLE FALLS
5 JUNE 1969



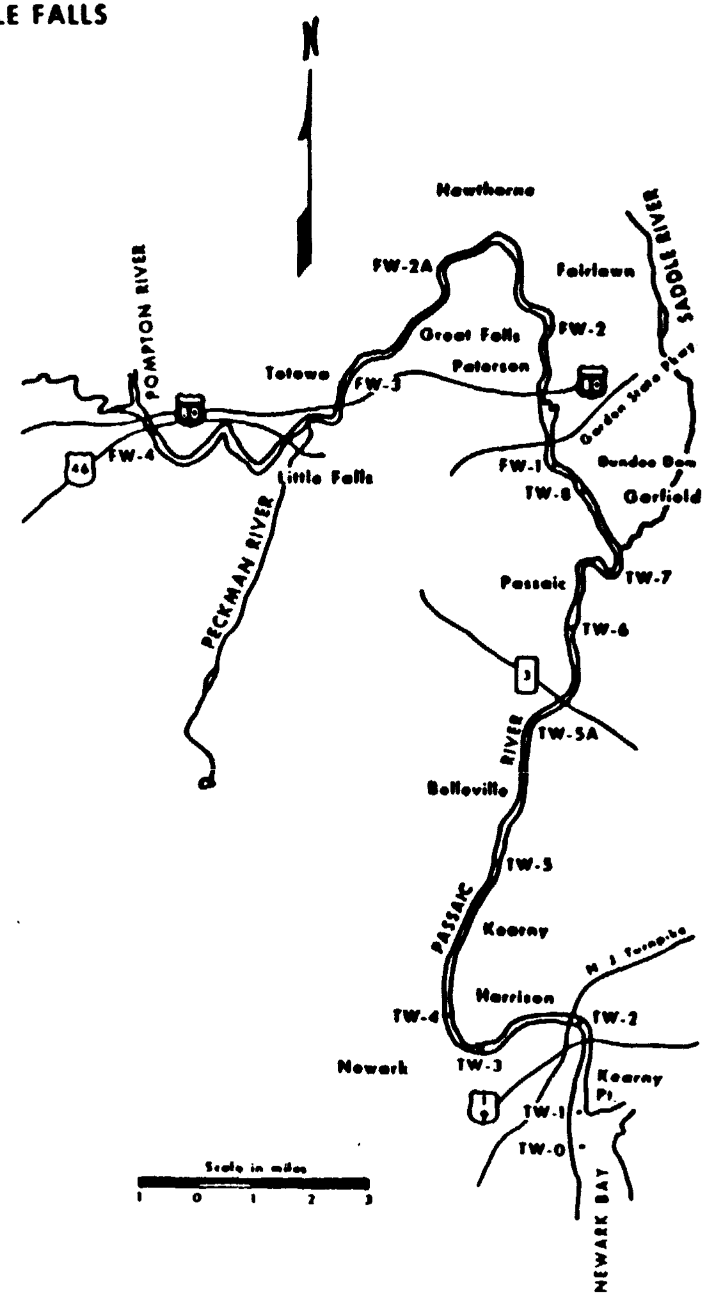


Figure 12

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Outfall Study - Passaic River

To determine the cause of poor water quality in the Passaic River, surveys were conducted by the Federal Water Pollution Control Administration and the New Jersey State Department of Health during June-November, 1969 to locate wastewater discharges to the Passaic River between Little Falls and Newark Bay. The Passaic Valley Sewerage Commissioners have also conducted surveys in an effort to identify outfall pipes discharging within their service area. The results of their study were not available for inclusion in this report.

The Federal Water Pollution Control Administration-New Jersey State Department of Health surveys were carried out by boat and car. Boat surveys were conducted at or near low tide and discharge pipes were located, measured, sampled (if flowing) and identified as accurately as possible with prominent land marks, municipalities, streets or industrial plant names. Supplemental surveys were conducted by car in areas inaccessible by boat and also to substantiate and/or further clarify the boat observations. Visits were made to industrial plants and municipal city engineers' offices to verify field observations, particularly in complex urban and industrial park areas where identification of a discharge or pipe with a single source was difficult. Attempts were made to identify all outfall pipes, whether discharging an effluent or not, and regardless of the pollutional characteristics of the discharge.

Table 6 summarizes the identification, observations and analytical results of samples taken during the surveys. Figure 13 shows the general location of each site where outfalls were found.

At least 182 outfalls were found at 76 site locations. Of this number, 120 pipes at 58 sites were observed discharging some quantity of wastewater during dry weather periods. Sampling and/or observations indicate that some of these flowing outfalls discharge effluents of high temperature or high color, and contain appreciable BOD, suspended solids and bacteria. Based upon sampling, the BOD loading discharged is estimated to be 17,000 pounds per day representing the raw discharge of an equivalent population of 100,000 persons. The suspended solids loading is estimated at 47,000 pounds per day.

It should be recognized that these organic and suspended solids loadings are for the time of sampling only and do not represent the total load that may be discharged from all the pipes observed. The total discharge load can only be determined by a thorough study including detailed visits to all industries and municipalities involved and a comprehensive sampling and analytical program.

Table 7 summarizes the Passaic River outfalls by type and municipal location. Of the 182 outfalls observed, 133 have been identified with industrial operations, 11 have been identified as major municipal combined sewer or storm water overflows and 38 identified as miscellaneous storm and surface runoff outlets. The larger industrial plants identified carry out chemical, metals, paint and rubber processing operations. The major combined storm sewers, located in Newark and Paterson, New Jersey, are suspected of receiving industrial wastewater flows. Efforts are continuing by the State of New Jersey and the Federal Water Pollution Control Administration to identify the sources of these flows.

TABLE 6
DIRECT WASTE DISCHARGES
PASSAIC RIVER 1/

Map Ident. No.	Source Municipality	River Mile 2/	Pipe Size	Est. Flow mgd	Temp. °C	BOD mg/1	Total Suspended Solids mg/1	pH	Total Coliform Org./100 ml	Fecal Coliform Org./100 ml	Remarks
1	Passaic Valley Severage Comm. 3/ 4/ Newark	0.1	undetermined	-	-	-	-	-	-	-	BOD = 241 mg/1 yellow color, odor
2	Vulcan Materials 3/ 4/ Newark	0.6	36", 6", 8"	-	-	-	-	-	-	-	High BOD, pH = 9.6 - 13.4
3	Ashland Chemical Co. 4/ Newark	1.1	3" 24"	-	-	-	-	-	-	-	Temp. >70°C Q = 0.05 mgd
4	Revere Smelting & Refining Co. 3/ 4/ Newark	1.1	Open ditch	-	-	-	-	-	-	-	BOD = >421 mg/1 Ether sol. = 14 mg/1 yellow color, pH = 2.7 Q = 0.25 mgd
5	Celanese Chemical Co. 3/ 4/ Newark	1.1	6"	-	-	-	-	-	-	-	BOD = >430 mg/1 Q = 0.25 mgd
6	Essex Chemical Corp. 3/ Newark	1.4	18", 18", 18", 15"	0.1	25.0	nil	352	6.5	$32x10^4$	$28x10^3$	BOD = <8.0 mg/1, pH = 8.2 4/
7	Roanoke Ave. Storm Sewer 3/ Newark	1.7	60"	1.90	27.0	740	1,230	6.7	$75x10^4$	$31x10^3$	Oil & chemical odor BOD = 382 mg/1, pH = 8.8 Ether sol. = 228 mg/1 Phenol = 1.5 ppm 4/
8	Western Electric Kearny	1.9	18", 18", 18", 21" other 10"	18" = .01 18" = slight	25.0 -	nil -	218 -	6.7 -	$26x10^3$ -	$22x10^2$ -	
9	Surface Runoff Kearny	2.1	48", 6", 18"	-	-	-	-	-	-	-	
10	Surface Runoff Lincoln Hwy Sew Kearny	2.1	12"	-	-	-	-	-	-	-	
11	Alcan Aluminum Corp. of America 3/ Kearny	2.2	4", 2", several other pipes 3"	4" = .01 2" = .02 -	42.0 44.0 -	2 7.4 -	42 60 -	7.7 7.6 -	10 10 -	4 4 -	Cr = 122 ppm Cn = 70 ppm pH = 4.3 4/
12	Storm Sewer 3/ Newark	2.5	18", 18"	-	-	-	-	-	-	-	
13	Kramer Chemical Co. 3/ Kearny	2.5	Flow through 8" hole in bulkhead	0.001	22.0	nil	580	12.0	10	4	
14	Monsanto Chemical Co. Kearny	2.7	27" with V notched weir	0.20	43.5	nil	68	8.8	$26x10^3$	$71x10^2$	
15	Public Service Essex Gen. Station Newark	2.8	28", very large outlet with gate	very large 28"-very lg.	33.0 38.5	nil 7.4	8 236	7.0 8.7	$38x10^4$ $21x10^3$	$60x10^2$ $40x10^2$	
16	Hudson County Mosquito Control Kearny	3.0	12"	large-under pressure	19.0	nil	312		$45x10^3$	40	
17	Commercial Solvents 4/ Newark	3.1	2"	-	-	-	-	-	-	-	
18	Blanchard Street Storm Sewer 3/ 4/ Newark	3.2	-	-	-	-	-	-	-	-	pH = 6.4

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TABLE 6 (Cont'd.)

Map Ident. No.	Source Municipality	River Mile 2/	Pipe Size	Est. Flow mgd	Temp. °C	BOD mg/1	Total Suspended Solids mg/1	pH	Total Coliform Org./100 ml	Fecal Coliform Org./100 ml	Remarks
19	Interstate Soap Co. 3/ 4/ Newark	3.3	Flow from under building	-	-	-	-		-	-	BOD = >420 mg/1, Ether sol. = 145 mg/1, pH = 5.8 suspended solids = 1104 mg/1
20	Lockwood Street Storm Sewer 3/ Newark	3.4	Undetermined size	-	-	-	-	-	-	-	
21	Benjamin Moore Paint 3/ Newark	3.4	60", 10"	60" = slight	24.5	18.2	178	-	$45x10^4$	$38x10^2$	60" - BOD = 61 mg/1 pH = 7.7 4/
				10" = .01	21.5	nil	62	-	$73x10^2$	$16x10^1$	10" - BOD = 183 mg/1 pH = 7.2 4/
22	Sherwin-Williams Newark	3.6	4"	0.05	30.2	nil	132	6.7	$43x10^4$	$90x10^2$	Colored discharge
			12"	0.25	25.0	nil	92	7.4	$60x10^3$	$41x10^2$	
			6"	0.60	25.0	nil	132	7.0	$21x10^4$	$90x10^2$	
			8"x10" opening	0.12	36.0	63.5	120	7.0	$86x10^3$	$33x10^2$	
			7"	0.01	25.0	41.4	14	3.3	10	4	
			3"	-	-	-	-	-	-	-	
			18"	-	-	-	-	-	-	-	
			Several others	-	-	-	-	-	-	-	
23	Barth Smelting & Refining Co. 4/ Newark	4.0	10"	-	-	-	-	-	-	-	pH = 7.3, Ether sol. = 2.0 mg/1
24	Storm Sewer 3/ Newark	4.4	36"	-	-	-	-	-	-	-	
25	Mott Street Storm Sewer 3/ Newark	4.5	41"	0.78	20.5	nil	28	6.0	$15x10^4$	$70x10^2$	
26	Storm Sewer from Ind. Area - Guyon Harrison	4.6	6'x6'	-	-	-	-	-	-	-	pH = 6.5, Ether sol. = 160 mg/1 4/
27	Public Service 3/ Harrison	4.8	72"	Small	27.0	nil	164	6.8	$62x10^3$	$27x10^2$	Ether sol. = 363 mg/1 4/
28	Otis Elevator 3/ Harrison	5.2	18", 8", 6", small pipes	-	-	-	-	-	-	-	Pipes flowing samples could not be taken 8": Ether sol. = 699 mg/1 pH = 6.0 4/
29	NOPCO Harrison	5.6	4"	0.02	19.0	nil	4	-	$24x10^2$	$12x10^1$	Colored discharge
			4"	0.003	20.5	74.0	8	-	10	4	
			4"	0.09	25.0	nil	132	-	$99x10^3$	$75x10^2$	
			12"	0.20	37.0	92.8	72	-	$68x10^3$	$51x10^2$	
			6"	0.88	24.5	nil	164	-	$10x10^4$	$11x10^3$	
			2½"	Large	24.0	nil	200	-	$20x10^4$	$17x10^3$	
			6"	0.08	37.0	nil	154	-	$79x10^3$	$65x10^2$	
30	Storm Sewer Harrison Ave Harrison	6.1	15"	-	-	-	-	-	-	-	
31	Hillside Metal Products Newark	6.4	8"	0.01	21.0	3.8	50	6.0	$30x10^2$	$56x10^1$	
			8"	0.05	37.0	5.8	60	3.5	$39x10^3$	$35x10^2$	
			6", other pipes	-	-	-	-	-	-	-	
32	Congoleum-Nairn, Inc. 4/ Kearny	7.1	4"	0.3	-	-	-	-	-	-	
33	Pittsburgh Plate Glass Co. Newark	7.3	2-36"	-	-	-	-	-	-	-	Pipes flowing samples could not be taken
			several other pipes	-	-	-	-	-	-	-	

TABLE 6 (Cont'd.)

Map Ident. No.	Source Municipality	River Mile 2/	Pipe Size	Est. Flow mgd	Temp. °C	BOD mg/1	Total Suspended Solids mg/1	pH	Total Coliform Org./100 ml	Fecal Coliform Org./100 ml 4	Remarks
34	Pettit Marine Paint (T) Belleville	9.8	24"	0.06	19.6	5.4	28	7.6	$83x10^3$	$11x10^3$	Colored discharge
			24"	0.04	19.3	3.8	26	7.8	$73x10^3$	$13x10^3$	
			24"	0.03	19.0	4.8	24	7.6	$20x10^4$	$13x10^2$	
			24"	0.03	19.0	3.4	26	7.4	$19x10^4$	$90x10^2$	
35	Storm Sewer Belleville	9.8	18"	0.04	22.0	nil	396	7.0	$17x10^3$	$20x10^2$	
36	Storm Sewer Belleville	9.9	24"	0.06	22.5	nil	784	7.0	$56x10^3$	$60x10^2$	
37	Storm Sewer Belleville	9.9	36"	Large	19.0	5.2	60	7.2	$62x10^3$	$55x10^2$	
38	Walter Kidde (T) Belleville	10.0	12"	0.04	26.0	nil	428	7.2	$31x10^4$	$57x10^2$	
			12"	0.12	26.0	12	320	7.2	$22x10^4$	$55x10^2$	
			12"	0.42	26.0	15.2	434	7.2	$16x10^4$	$14x10^3$	
39	Walter Kidde (T) Belleville	10.1	48"	Large	29.0	11.4	464	7.0	$55x10^4$	$31x10^3$	
40	Storm Sewer from Belleville Ind. Center Belleville	10.3	36"	0.16	23.0	nil	270	-	$20x10^4$	$37x10^2$	Oil on surface
41	Storm Sewer Nutley	11.1	24"	0.26	17.0	nil	16	8.0	$71x10^3$	$23x10^1$	
42	Storm Sewer (T) Clifton	12.9	48"	0.97	27.0	2.2	26	7.2	$35x10^1$	4	
43	Storm Sewer Passaic	14.1	36"	0.25	18.0	2.2	8	7.4	$13x10^3$	$24x10^2$	
44	PVSC Combined Overflow Passaic	14.4	48"	0.31	25.0	5.4	72	7.0	$95x10^4$	$23x10^4$	
45	Uniroyal, Inc. Passaic	14.6	8"	0.01	69.0	10.4	192	10.5	10	4	Colored discharge
			8"	0.01	21.0	nil	290	7.4	$20x10^1$	4	
			8"	0.01	21.5	nil	186	7.0	$20x10^3$	$32x10^1$	
			8"	0.04	29.5	nil	14	7.5	$52x10^3$	12	
			24"	7.82	24.0	3.1	88	7.1	$47x10^2$	$28x10^1$	
46	Storm Sewer Wallington	14.9	6"	-	-	-	-	-	-	-	
47	Parra Print Shop Passaic	15.1	4"	0.01	41.0	10.2	358	10.4	10	4	
48	J. L. Prescott Passaic	15.1	Several pipes	-	-	-	-	-	-	-	White color
49	Ind. Disc. to Dundee Canal (T) Passaic	14.4/0.25	Undetermined size	-	-	-	-	-	-	-	Pipes flowing sample could not be taken
50	Storm Sewer Passaic	15.3	24"	-	-	-	-	-	-	-	
51	Storm Sewer Garfield	15.9	Undetermined size	-	-	-	-	-	-	-	
52	Storm Sewer Passaic	16.0	Undetermined size	-	-	-	-	-	-	-	

TABLE 6 (Cont'd.)

Map Ident. No.	Source Municipality	River Mile 2/	Pipe Size	Est. Flow mgd	Temp. °C	BOD mg/1	Total Suspended Solids mg/1	pH	Total Coliform Org./100 ml	Fecal Coliform Org./100 ml	Remarks
53	Storm Sewer Passaic	16.0	27"	Medium	24.0	120	150	-	$>80x10^4$	$>30x10^3$	Sewage appearing effluent
54	Storm Sewer Passaic	16.2	18"	Small	-	-	-	-	-	-	Sample could not be taken
55	Tenneco Chemicals Heyden Division Garfield	16.2	12" 13" 22" 24"	Large 0.01 Large Large	32.0 22.0 36.0 36.0	154 9.2 103 29.5	276 234 194 198	- - - -	$17x10^5$ $40x10^5$ $60x10^5$ $33x10^5$	$17x10^4$ $35x10^4$ $35x10^4$ $26x10^4$	May contain detergent, Dead fish in outfalls
56	Storm Drain Garfield	16.5	2"	-	-	-	-	-	-	-	
57	Whippany Paper-Clifton Mills Clifton	17.1	12", outfall w/gate	0.01	26.0	2.8	106	-	$15x10^5$	$22x10^4$	
58	Route 80 Storm Sewer Garfield	19.1	30" corrogated steel outfall	-	-	-	-	-	-	-	
59	19th Street Storm Sewer Paterson	19.7	84"	0.02	21.0	4.3	40	7.5	$64x10^1$	$15x10^1$	
60	Eastern Machine Co. Paterson	21.0	8"	-	-	-	-	-	-	-	
61	Storm Sewer Fair Lawn	21.8	24"	0.32	19.0	nil	10	7.4	$80x10^4$	$30x10^3$	
62	Bergen County Storm Sewer Fair Lawn	21.8	24" 10"	- -	- -	- -	- -	- -	- -	- -	
63	3rd Avenue Overflow Paterson	22.0	36"	-	-	-	-	-	-	-	Colored discharge
64	Bergen County Storm Sewer Fair Lawn	22.3	24"	0.08	29.0	nil	36	7.4	$46x10^1$	44	
65	1st Avenue Storm Sewer Paterson	22.3	24", 30"	-	-	-	-	-	-	-	White material in discharge
66	Storm Sewer from Fair Lawn Ind. Fair Lawn	22.3	4'x4' opening	-	-	-	-	-	-	-	
67	Storm Sewer Fair Lawn	22.5	3 pipes of Undetermined size	-	-	-	-	-	-	-	
68	Continental Piece Dyeing & Finishing Co. Paterson	22.5	2-2"	0.002	>50.0	1.4	30	-	10	4	Oil on bank
69	Storm Sewer Prospect Park	23.7	2-36"	-	-	-	-	-	-	-	
70	Storm Sewer Prospect Park	23.7	18"	-	-	-	-	-	-	-	Oil stain in pipe
71	Associated Dye & Print Co. Paterson	23.7	6" 3" Undetermined size	0.03 very large .24	>50.0 >50.0 -	1.8 9.7 92.0	16 104 270	- - 7.8	20 10 $28x10^3$	4 4 $11x10^3$	Colored discharge

TABLE 6 (Cont'd.)

Map Ident. No.	Source Municipality	River Mile 2/	Pipe Size	Est. Flow mgd	Temp. °C	BOD mg/l	Total Suspended Solids mg/l	pH	Total Coliform Org./100 ml	Fecal Coliform Org./100 ml	Remarks
72	Witco Chemical Co. Paterson	24.0	2-4"	-	-	-	-	-	-	-	
73	Leon Street Storm Sewer (PVSC Overflows) Paterson	24.0	18"	0.01	30.5	98.7	450	7.7	$11x10^4$	$29x10^3$	
74	Public Service Paterson	24.2	8 pipes of varying sizes	-	-	-	-	-	-	-	Pipes flowing, samples could not be taken
75	Storm Sewer Paterson	26.6	30"	-	-	-	-	-	-	-	
76	Storm Sewer West Paterson	27.0	36", 12", 48"	-	-	-	-	-	-	-	

1/ Data contained in this Table have been obtained from the Federal Water Pollution Control Administration and New Jersey State Department of Health surveys conducted during June-November, 1969.

2/ River mile measured from mouth of River at Newark Bay (Buoy RN 24).

3/ Waste source under pollution abatement orders issued by the New Jersey State Department of Health.

4/ New Jersey State Department of Health data.

(T) Tentatively identified sources.

PASSAIC RIVER
DIRECT WASTE DISCHARGE
MUNICIPAL AND INDUSTRIAL

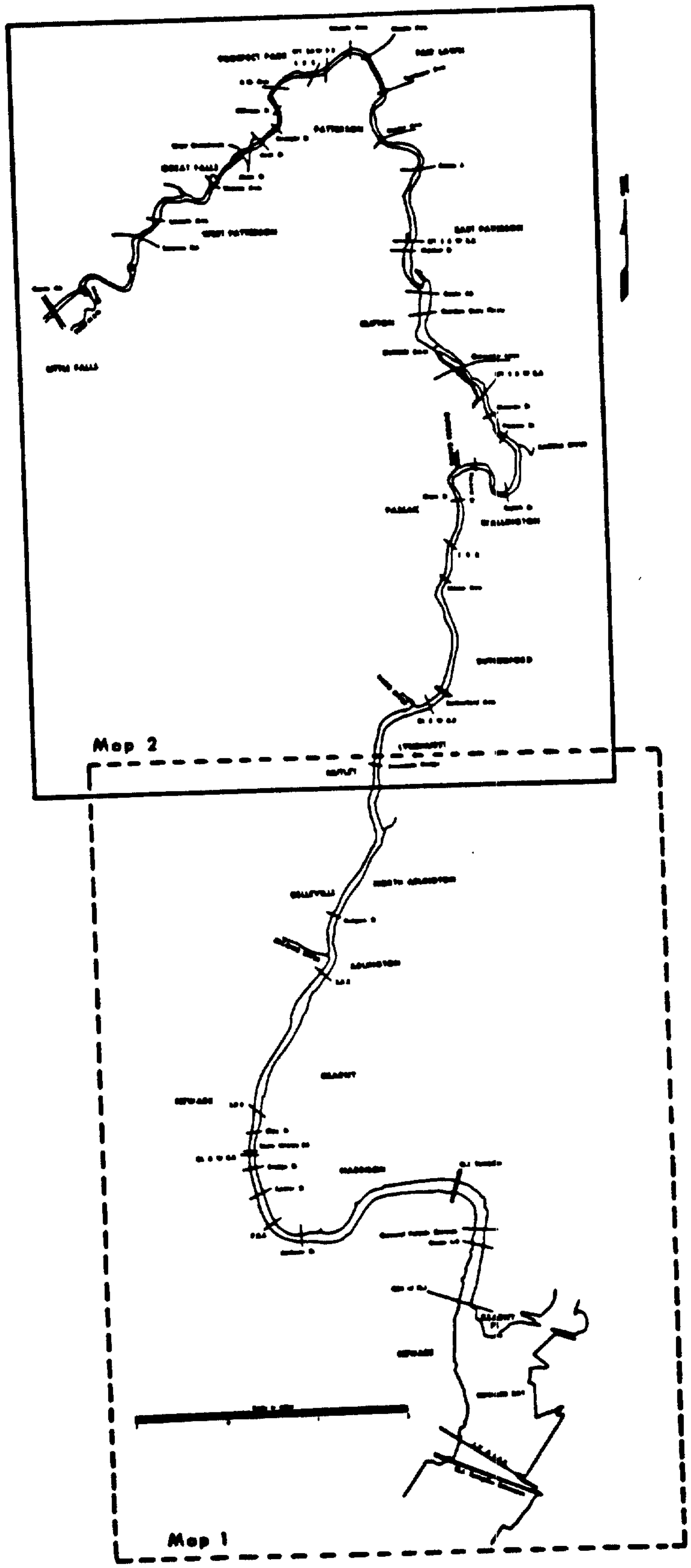
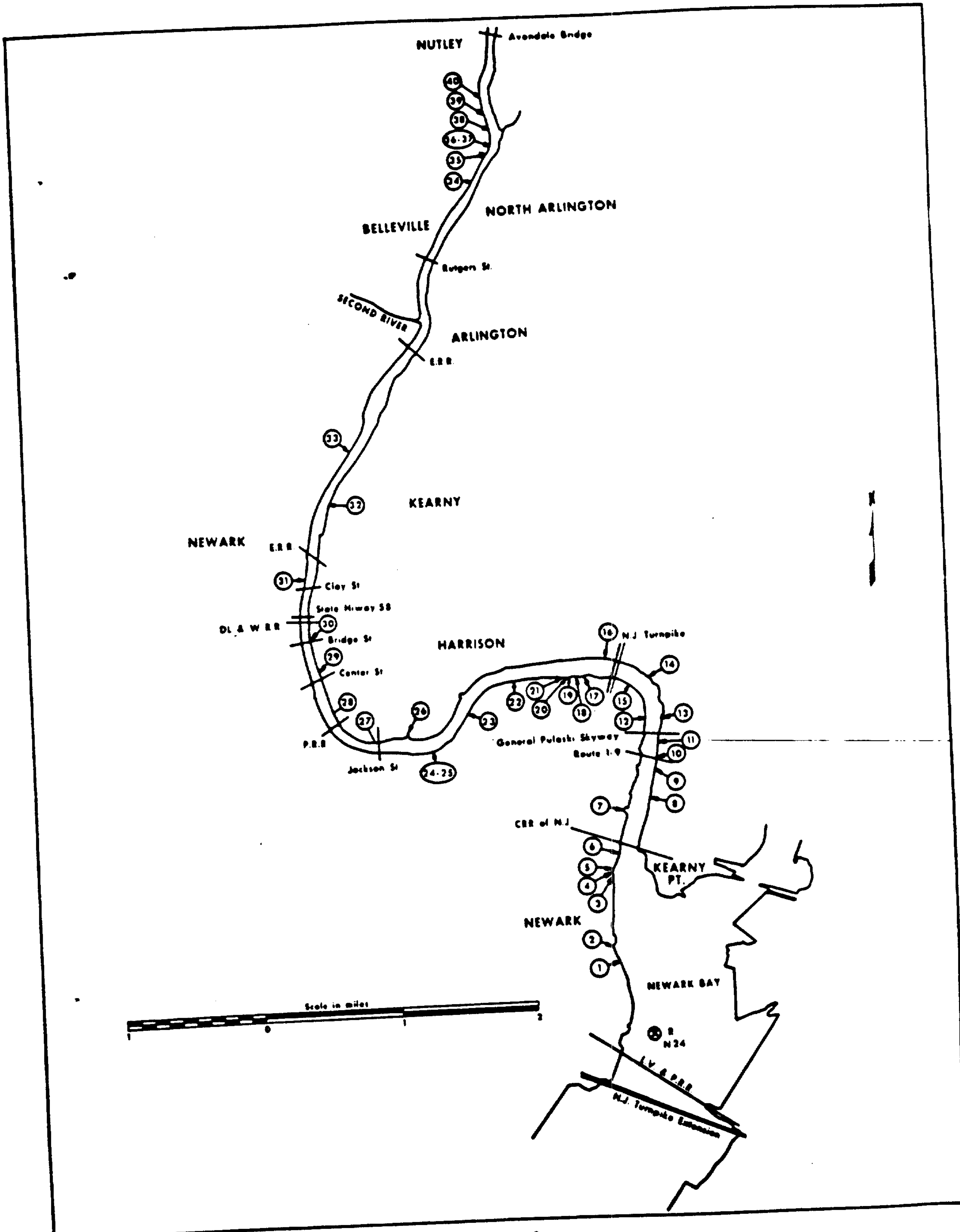


Figure 13



Map 1

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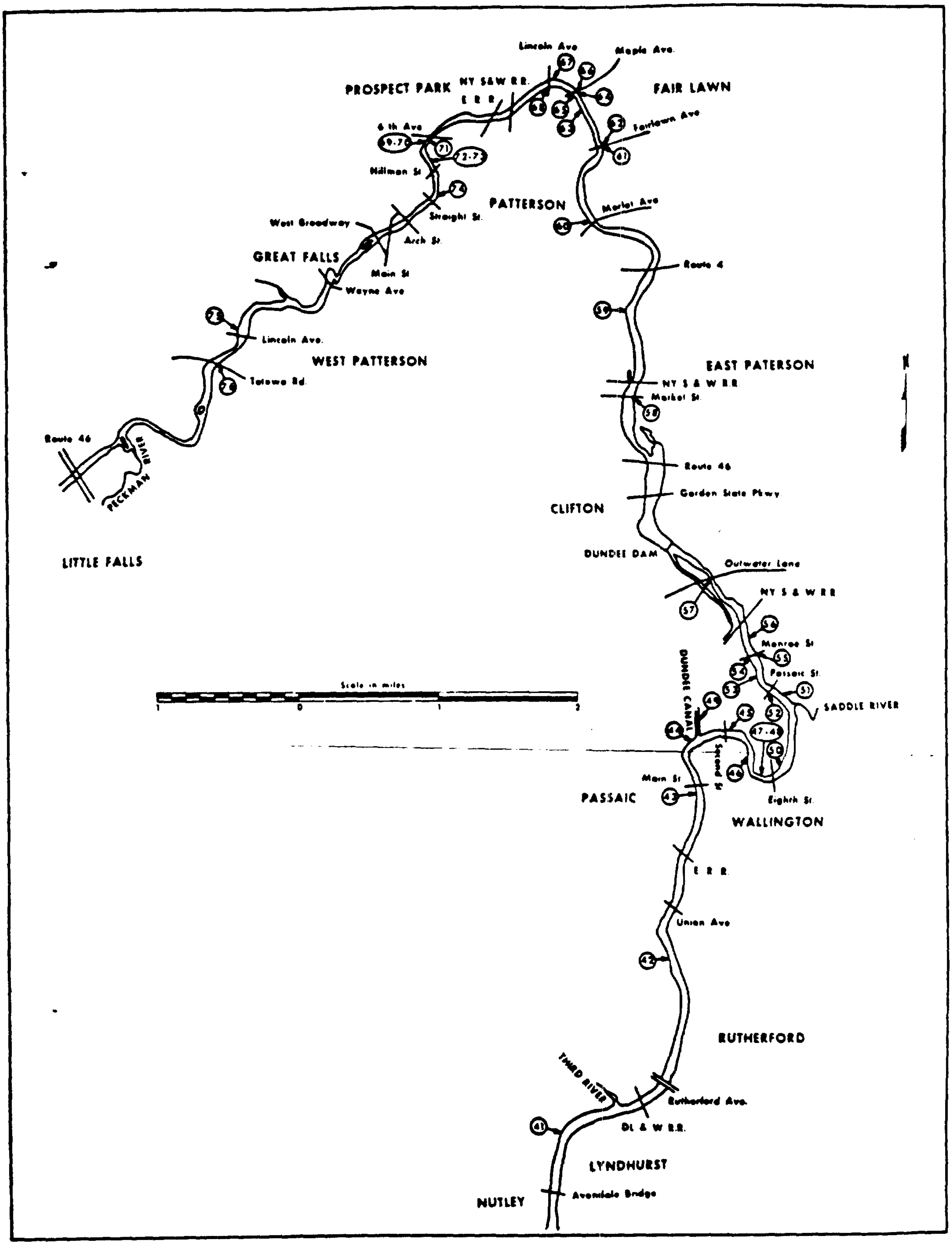

Map 2

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TABLE 7

DIRECT WASTE DISCHARGES BY
TYPE AND MUNICIPALITY
PASSAIC RIVER

Municipality	No. of Sites	Total No. of Pipes	No. of Sites with Flowing Pipes	Number of Pipes from Industry	Number of Major Storm Sewers or Overflows	Number of Miscellaneous Storm Sewers and Surface Drains
Newark	20	49	16	41	5	3
Kearny	8	38	7	33	-	5
Belleville	7	12	7	9	-	3
Harrison	5	18	4	17	-	1
Nutley	1	1	1	-	-	1
Wallington	1	1	-	-	-	1
Passaic	10	16	10	10	1	5
Clifton	2	3	2	2	-	1
Garfield	4	8	2	4	-	4
Paterson	10	22	7	16	5	1
Fair Lawn	5	8	2	1	-	7
West Paterson	1	3	-	-	-	3
Prospect Park	2	3	-	-	-	3
Total	76	182	58	133	11	38

Of the discharges listed in Table 6, the New Jersey State Department of Health, based on the results of sampling and surveillance activities, has issued pollution abatement orders to the following:

Passaic Valley Sewerage Commissioners, Newark, N. J.
Vulcan Materials, Newark, N. J.
Revere Smelting & Refining Company, Newark, N. J.
Celanese Chemical Company, Newark, N. J.
Essex Chemical Corporation, Newark, N. J.
City of Newark
Alcan Aluminum Corporation of America, Kearny, N. J.
Kramer Chemical Company, Kearny, N. J.
Interstate Soap Company, Newark, N. J.
Benjamin Moore Paint, Newark, N. J.
Public Service, Harrison, N. J.
Otis Elevator, Harrison, N. J.

Continued surveillance and sampling by the New Jersey State Department of Health could result in the issuance of additional orders to municipalities and industries who are not conforming to State standards and regulations.

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3. Passaic Valley Sewerage Commissioners - Contracts with Municipalities (May 15, 1911, September 20, 1911, June 1, 1917, March 27, 1918, July 29, 1921, February 23, 1922, November 19, 1924, January 13, 1925, October 26, 1926, October 21, 1942).

4. New Jersey Statutes Annotated, Title 26, Chapter 2E, Section 1. Public Sanitary Sewerage Facilities Act (1965).

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14. Water Supply and Wastewater Disposal, Fair and Geyer, Eighth Printing (1967).

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APPENDIX A

8. The benefits which would result from increased State water pollution control activities under such programs as the proposed $1 billion "Pure Water" Bond Issue in New York State are acknowledged.

9. All discharge sources to the Hudson River and its tributaries, whether public, Federal installations, or industrial, shall receive a minumum of secondary treatment or its equivalent, and effective disinfection of the effluents as required to protect water uses.

10. Industrial plants shall improve practices for the segregation and treatment of wastes to effect the maximum reduction of the following:

    a) Acids and alkalies;

    b) Oil and tarry substances;

    c) Phenolic compounds and organic compounds that contribute to taste and odor problems;

    d) Nutrient materials including ammonia and nitrogenous phosphoric compounds;

    e) Suspended material;

    f) Toxic and highly colored wastes;

    g) Oxygen requiring substances;

    h) Heat;

    i) Foam producing discharges;

    j) Other wastes which detract from recreational uses, esthetic enjoyment or other beneficial uses of the waters.

11. Surveillance and monitoring of the operation and maintenance of sewage

and waste treatment facilities in the conference area shall be conducted by the States of New Jersey and New York, the Interstate Sanitation Commission, and the Department of Health, Education, and Welfare at locations and frequencies to yield reliable values of waste outputs and resulting receiving water quality, and to show their variations.

12. The Federal conferee recommends the following time schedule for the foregoing remedial program:

    a) Designs for remedial facilities completed by January 1, 1967;

    b) Financing arrangements completed by April 1, 1967;

    c) Construction started by July 1, 1967;

    d) Construction completed and plants placed into operation by January 1, 1970;

    e) Commensurate schedules to be adopted for the interception and treatment of industrial wastes and wastes from Federal installations;

    f) Existing schedules calling for earlier completion dates are to be met.

13. The magnitude of the pollution problem caused by discharges from combined sewer overflows is recognized. The Department of Health, Education, and Welfare, in cooperation with the States of New Jersey, New York, and the Interstate Sanitation Commission, will undertake a review of the problem and develop a program for action for consideration by the Federal Government, the States and the Interstate Sanitation Commission by December 31, 1968.

The construction of combined sewer systems in newly developed or redeveloped urban areas shall be prohibited, and existing combined sewers shall be eliminated wherever feasible.

Programs shall be established for surveillance of existing combined sewer systems and flow regulating structures to convey the maximum practicable amount of combined flows to and through treatment plants.

14. The conferees representing New Jersey, New York and the Interstate Sanitation Commission call attention to the fact that financing is the key to sewage treatment plant construction. In the past, the financial burden for construction of sewage treatment facilities has been borne by municipalities and industry. This method of financing must be changed if the progress visualized in this conference is to be achieved.

15. Regional planning is often the most logical and economical approach towards meeting water pollution problems. The water pollution control agencies of New Jersey, New York, and the Interstate Sanitation Commission, and the Department of Health, Education, and Welfare, will encourage such regional planning activities.

SUMMARY OF CONFERENCE
(SECOND SESSION)

POLLUTION OF INTERSTATE WATERS
OF THE
HUDSON RIVER AND ITS TRIBUTARIES

(NEW YORK-NEW JERSEY)

September 20, 1967

The second session of the conference in the matter of pollution of the interstate waters of the Hudson River and its tributaries (New York-New Jersey) was held on September 20, 1967, at New York, New York, under the provisions of section 10 of the Federal Water Pollution Control Act, as amended (33 U.S.C. 466 et seq.). The first session of the conference was held on September 28-30, 1965, at New York City.

The 158 mile reach of the Hudson River considered at the conference encompasses the Upper Bay of New York Harbor, including Newark Bay, the Kill Van Kull, the East and Harlem Rivers, and the main stem of the Hudson River from the Battery to the head of navigation at the Federal Lock at Troy, New York.

The following conferees representing the State water pollution control agencies of New York and New Jersey, the Interstate Sanitation Commission, and the U. S. Department of the Interior, participated in the conference:

Dwight F. Metzler	Deputy Commissioner New York State Department of Health Albany, New York

Roscoe P. Kandle, M.D.	Commissioner New Jersey State Department of Health Trenton, New Jersey
Thomas R. Glenn, Jr.	Director and Chief Engineer Interstate Sanitation Commission New York, New York
Lester M. Klashman	U. S. Department of the Interior Federal Water Pollution Control Administration Boston, Massachusetts
Murray Stein, Chairman	U. S. Department of the Interior Federal Water Pollution Control Administration Washington, D. C.

Also participating in the conference were the following:

Colonel R. T. Batson	District Engineer U. S. Army, Corps of Engineers New York, New York
Dr. Natale Colosi	Chairman, Interstate Sanitation Commission New York, New York
Dr. H. Jackson Davis (Represented by Carl Stefanic)	Commissioner of Health Rensselaer County Troy, New York
Paul DeFalco, Jr.	U. S. Department of the Interior Federal Water Pollution Control Administration Metuchen, New Jersey
Honorable Joseph A. Fusco (Represented by Alan Blake)	Assemblyman, 86th Assembly District Bronx County, New York
Arthur Handley	Division of Pure Water New York State Department of Health Albany, New York
James Harding	Division of Pure Water Westchester County, New York

Eugene E. Hult	Commissioner of Public Works New York, New York
Honorable Jacob K. Javits (Represented by Emil Frankel)	United States Senate Washington, D. C.
C. C. Johnson	Environmental Health Services New York City Health Department New York, New York
Richard W. Keeler	Rensselaer County Agency for Abatement and Control of Pollution Troy, New York
Honorable Robert F. Kennedy (Represented by Robert Green)	United States Senate Washington, D. C.
Dr. John A. Lyons	Albany County Sewer Agency Albany County, New York
Lawrence J. McCarren	General Services Administration New York, New York
James E. McShane	Maritime Administration U. S. Department of Commerce New York, New York
Honorable Frank D. O'Connor (Represented by James F. O'Donnell)	President, New York City Council New York, New York
William Lathrop Rich	Committee for the New York-Montreal Seaway New York, New York
Honorable Nelson A. Rockefeller	Governor, State of New York State Capitol Albany, New York
Honorable Whitney North Seymour, Jr.	State Senator, 26th District State of New York
William K. Shaffer	Division of Pure Waters New York State Department of Health Albany, New York
Honorable John H. Warden	Mayor, City of Rensselaer Rensselaer, New York

The Chairman of the conference pointed out that:

1. Under the Federal Water Pollution Control Act, as amended (33 U.S.C. 466 et seq.), pollution of interstate or navigable waters which endangers the health or welfare of any persons is subject to abatement under procedures described in section 10 of the Federal Act.

2. The first step of these procedures is the calling of a conference.

3. The purpose of the conference is to bring together representatives of the States, the interstate agency, and the U. S. Department of the Interior to review the existing situation and the progress which has been made, to lay a basis for future action by all parties concerned, and to give the States, localities, and industries an opportunity to take any remedial action which may be indicated, under State and local law.

4. The first session of the conference was held on September 28-30, 1965, in accordance with requests from the Honorable Nelson A. Rockefeller, Governor of New York, and the Honorable Richard J. Hughes, Governor of New Jersey, and on the basis of reports, surveys, or studies under the provisions of the Federal Water Pollution Control Act. At the first session, the conferees recommended a remedial program for pollution abatement. Subsequent to the conference, the Secretary recommended a time schedule for implementation of the remedial program.

5. The second session of the conference was called for the purpose of reviewing compliance with the recommended schedule of remedial action.

At the second session the conferees agreed upon the following conclusions and recommendations:

1. Pollution of the interstate waters of the Hudson River and its tributaries is occurring due to the discharge of inadequately treated municipal and industrial wastes.

2. Considerable progress has been made toward abating this pollution problem and the programs underway, when carried to their logical conclusion, will abate and control this pollution.

3. All wastes prior to discharge into the waters covered by the conference (a) shall be treated to provide a minimum of 80% reduction of biochemical oxygen demand at all times. It is recognized that this will require a design for an average removal of 90% of biochemical oxygen demand. Or (b) shall be treated, as approved by the State water pollution control agency, to the degree necessary to meet the water quality standards approved by the Secretary of the Interior under the Water Quality Act of 1965.

4. All the waters covered by the conference shall receive effective disinfection of the effluents as required to protect water uses.

5. The conferees agree that all remedial facilities will be placed in operation by 1970 except the proposed North River facility which cannot be completed and in operation until 1972.

6. The State and interstate conferees agree that recent actions in Congress make it appear that the Fiscal Year 1968 appropriations will be less than one-half the inadequate authorization of $450 million. It is destructive of pollution control efforts to continue

a system in which actual appropriations are far below statutory authorizations. It should be understood that congressionally authorized amounts constitute a serious moral obligation on which States and municipalities should be able to rely in planning their projects for water quality improvement. Unless congressional appropriations are reasonably consistent with the authorizations enacted by Congress, it is obviously impossible for any municipality to receive the 55% of construction cost in Federal aid clearly provided in the Clean Water Restoration Act of 1966. If the Congress intends to fund projects 55%, then increases in the existing authorizations, as well as increases in the appropriations are needed.

7. Periodic progress meetings shall be called by the chairman after consultation with the conferees.

CONCLUSIONS AND RECOMMENDATIONS
OF THE
CONFEREES
(THIRD SESSION)

POLLUTION OF INTERSTATE WATERS
OF THE
HUDSON RIVER AND ITS TRIBUTARIES

(NEW YORK-NEW JERSEY)

June 18, 19, 1969

The conferees agreed upon the following conclusions and recommendations:

1. The States and the interstate water pollution control agencies, that is, the New Jersey State Department of Health, the New York State Department of Health and the Interstate Sanitation Commission, are taking effective action to abate pollution in accordance with the agreements arrived at at the Conference on Pollution of Interstate Waters of the Hudson River and its Tributaties held under the provisions of the Federal Water Pollution Control Act.

2. An extensive pollution abatement program is moving forward toward the attainment of water quality agreed on by the conferees representing the States of New Jersey, New York, the Interstate Sanitation Commission and the Federal Government.

3. The treatment required from sources discharging into the Hudson River and its tributaries is consistent throughout the Basin and mutually satisfactory to all the regulatory agencies concerned.

4. In view of the complexities of the problem, the conferees will plan to meet again in the late fall or winter of 1970 to evaluate progress on a case by case basis.

5. The activities of the Interstate Sanitation Commission in analyzing combined sewer overflows in the Hudson River Conference Area is

recognized. The conferees will participate with and support the Interstate Sanitation Commission in a detailed examination of storm water overflows as the first stage in the development of a remedial program, as needed; the New York State Department of Health will carry out that portion of this activity in the Hudson River Basin outside the jurisdiction of the Interstate Sanitation Commission. A joint report on this subject will be made to the conferees at the next session.

6. The State and interstate conferees agree that recent Federal action makes it appear that the Fiscal Year 1970 appropriations will be about one-fifth the authorization of $1 billion. They urge that the authorized amounts be appropriated if water pollution control needs are to be met. Further, the reimbursement features of the present statute must be retained.

SUMMARY OF CONFERENCE
(First Session)

POLLUTION OF THE INTERSTATE WATERS

OF THE

HUDSON RIVER
AND ITS TRIBUTARIES
(NEW YORK-NEW JERSEY)

September 28-30, 1965

In accordance with requests from Nelson A. Rockefeller, Governor of New York, and Richard J. Hughes, Governor of New Jersey, and on the basis of reports, surveys, or studies, the Secretary of Health, Education, and Welfare on September 1, 1965, called a conference under the provisions of section 8 of the Federal Water Pollution Control Act (33 U.S.C. 466 et seq.) in the matter of pollution of the interstate waters of the Hudson River and its tributaries. The conference was held September 28 through 30, 1965, at the Waldorf Astoria Hotel, New York, New York.

The 158 mile reach of the Hudson River considered at the conference encompasses the Upper Bay of New York Harbor, including Newark Bay, the Kill Van Kull, the East and Harlem Rivers, and the main stem of the Hudson River from the Battery to the head of navigation at the Federal Lock at Troy, New York.

The following conferees representing the State water pollution control agencies of New York and New Jersey, the Interstate Sanitation

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Commission, and the U. S. Department of Health, Education, and Welfare, participated in the conference:

Robert D. Hennigan	Director, Bureau of Water Resources Services New York State Department of Health Albany, New York
Roscoe P. Kandle, M.D.	State Commissioner of Health New Jersey State Department of Health Trenton, New Jersey
Alfred Fletcher	Chief Engineer New Jersey State Department of Health Trenton, New Jersey
E. Powers Mincher	Counsel New Jersey State Department of Health Trenton, New Jersey
Thomas R. Glenn, Jr.	Director and Chief Engineer Interstate Sanitation Commission New York, New York
Earl J. Anderson	U. S. Department of Health, Education, & Welfare New York, New York
Murray Stein, Chairman	U. S. Department of Health, Education, & Welfare Washington, D. C.

The Honorable John W. Gardner, Secretary of Health, Education, and Welfare, presented a statement concerning Federal-State responsibilities and programs for abatement of pollution of the Hudson River.

The following also participated in the conference:

Mark Abelson	Northeast Regional Coordinator U. S. Department of the Interior Boston, Massachusetts

Colonel Richard T. Batson	District Engineer U. S. Army Engineer District New York, New York
Lester Blaschke	Chief, Office of Estuarine Surveillance & Sanitary Control Division of Environmental Engineering and Food Protection U. S. Public Health Service Washington, D. C.
Russell D. Butcher	Conservation Specialist National Audubon Society New York, New York
Honorable Clifford P. Case (by Gar Kaganovich)	United States Senate Washington, D. C.
Dr. Natale Colosi	Chairman, Interstate Sanitation Commission New York, New York
H. Jackson Davis, M.D.	Commissioner of Health Rensselaer County Troy, New York
Paul DeFalco, Jr.	Director, Hudson-Champlain and Metropolitan Coastal Water Pollution Control Project U. S. Department of Health, Education, & Welfare Metuchen, New Jersey
Stephen G. Doig, Jr.	County Attorney Rockland County New York, New York
Honorable John Dow	Congressman, 27th District, New York House of Representatives Washington, D. C.
Mrs. Kenneth Greenawalt	President, League of Women Voters New York, New York
Alan Gussow	Citizens Committee for the Hudson River Congress, New York

Richard M. Greening	Regional Hydrologist, Weather Bureau Environmental Science Services Administration New York, New York
Hollis S. Ingraham, M.D.	Commissioner of Health New York State Department of Health Albany, New York
Honorable Jacob K. Javits (by Miss Patricia Connell)	United States Senate Washington, D. C.
Honorable Robert F. Kennedy	United States Senate Washington, D. C.
Honorable John V. Lindsay (by Murray Stein)	Congressman 17th District, New York House of Representatives Washington, D. C.
Donald E. Lynch	Executive Director Citizens Committee for Clean Water New York, New York
Honorable Edwin G. Michaelian	County Executive Westchester County White Plains, New York
Olin T. Mirteenes	District Ship Custody Officer Maritime Administration U. S. Department of Commerce New York, New York
Eugene H. Nickerson	Nassau County Executive Nassau County, New York
William Henry Osborn	President, Hudson River Conservation Society New York, New York
Honorable Richard L. Ottinger	Congressman, 25th District, New York House of Representatives Washington, D. C.
Brigadier General David S. Parker	Division Engineer, North Atlantic Division Corps of Engineers New York, New York

Mrs. Helen Putnam	Friends of the Hudson New York, New York
Honorable Ogden R. Reid	Congressman, 26th District, New York House of Representatives Washington, D. C.
Honorable Joseph Y. Resnick (by John W. Logan)	Congressman, 28th District, New York House of Representatives Washington, D. C.
Honorable Nelson A. Rockefeller	Governor, State of New York State Capitol Albany, New York
Ronald W. Spevack	Assistant State Chairman New Jersey State Jaycees
Dr. Clarence M. Tarzwell	Director, National Marine Quality Laboratory U. S. Public Health Service Wakefield, Rhode Island
Gwyn Thomas	Executive Assistant to the President Associated Industries of New York State, Inc. Albany, New York
Honorable Robert F. Wagner	Mayor, City of New York New York, New York
Mrs. John Wallace	New York State Congress of Parents and Teachers, Inc. Garden City, New York
Dr. Harold G. Wilm	Conservation Commissioner Chairman, New York State Water Resources Commission Albany, New York
Rod Vandivert	Scenic Hudson Preservation Council New York, New York

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The Chairman of the conference pointed out that:

1. Under the Federal Water Pollution Control Act (33 U.S.C. 466 et seq.), pollution of interstate waters which endangers the health or welfare of persons in a State other than that in which the discharges originate is subject to abatement under procedures described in section 8 of the Federal Act.
2. The first step of this procedure is the calling of a conference.
3. The purpose of this conference is to bring together representatives of the State and interstate water pollution control agencies and the U. S. Department of Health, Education, and Welfare, to review the existing situation and the progress which has been made, to lay a basis for future action by all parties concerned, and to give the States, localities, and industries an opportunity to take any indicated remedial action under State and local law.

Conferees representing the New York State Department of Health, the New Jersey State Department of Health, the Interstate Sanitation Commission, and the U. S. Department of Health, Education, and Welfare were present throughout the conference.

Representatives of the Department of Health, Education, and Welfare, presented a report on the Hudson River and its tributaries which covered sources of pollution, types of wastes discharged, and interferences with water uses.

Representatives of the New York State Department of Health, the New Jersey State Department of Health, and the Interstate Sanitation Commission presented statements concerning water quality in the Hudson River and its tributaries.

The conferees agreed upon the following conclusions and recommendations:

1. The Hudson River and its tributaries, considered by this conference, are interstate waters within the meaning of the Federal Water Pollution Control Act.
2. There is interstate pollution of these waters. This pollution is subject to abatement under the Federal Water Pollution Control Act.
3. Such pollution is caused by many factors including sewage and industrial waste discharges, oil, silt, sediment, heat, floating solids, nutrients, sludge deposits, and combined sewer overflows. Sources of pollution are in both New Jersey and New York.
4. This pollution interferes with recreation, commercial fishing, sport fishing, navigation, domestic and industrial water supplies, and esthetic values.
5. The States of New Jersey and New York and the Interstate Sanitation Commission are empowered to abate pollution and have active programs to accomplish this result. These programs include: establishment of water quality requirements; enforcement actions to abate waste discharges; development of comprehensive water pollution control programs; and fiscal incentives.

6. Delays in abating pollution are caused by the lack of adequate treatment facilities and the complex technical and financial problems presented by the use of a waterway serving the largest metropolitan area in the country.

7. Cognizance is taken of the activities of the U. S. Army Corps of Engineers and the Coast Guard in abating pollution resulting from oil, sludge, silt and floating debris, as well as the program of the Federal Government to abate pollution from all Federal installations.

   The Department of Health, Education, and Welfare shall advise and consult with other Federal Agencies in the area covered by the conference to see that all Federal installations install, construct and operate adequate pollution control facilities which will meet the requirements of the States and the Interstate agency concerned, as well as the Federal Government.

   The States and Interstate agency recognize that the Department of Health, Education, and Welfare is the Federal agency primarily charged with abatement of pollution of interstate or navigable waters. They recommend that the Department take the lead in coordinating the activities of all Federal agencies concerned with water quality in the Hudson River and its tributaries so that the Federal Government may have a unified approach in dealing with the States and Interstate agencies.

APPENDIX B

WATER QUALITY CRITERIA

STATE OF NEW YORK

CLASS I

DEFINITION OR BEST USAGE: Fishing and any other usages except bathing or shell-fishing for market purposes.

FLOW CONDITIONS:

1	Floating Solids	None which are readily visible and attributable to sewage, industrial wastes, or other wastes or which deleteriously increase the amounts of these constituents in receiving waters after opportunity for reasonable dilution and mixture with the wastes discharged thereto.
2	Settleable Solids	See Number 1.
3	Sludge Deposits	See Number 1.
4	Solid Refuse, Garbage, Cinders, Ashes, Oils, Sludge or Other Refuse	Garbage, Cinders, Ashes, Oils, Sludge or Other Refuse: None in any waters of the "Marine District" as defined by State Conservation Law. (See Remarks)
5	Sewage or Other Effluent	Effective disinfection if required by Interstate Sanitation Commission.
6	Oil, Grease, Oil Slicks, or Scum	Oil: See Number 13.
7	Coliform Density	Not Specified.
8	pH	Not Specified.
9	Dissolved Oxygen	An average of not less than 50% saturation during any week of the year, but not less than 3.0 ppm at any time.
10	Color	See Number 13.
11	Turbidity	Not Specified.
12	Taste, Odor	Not Specified.
13	Toxic Wastes, Deleterious Substances:	See over.
14	Heated Effluents and Temperature Criteria:	See over.

REMARKS: "The Marine District shall include the waters of the Atlantic Ocean within three nautical miles from the coastline and all other tidal waters within the State except the Hudson River northerly of the south end of (Cont'd.)

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WATER QUALITY CRITERIA STATE OF NEW YORK

CLASS I (Cont'd.)

13 Toxic Wastes, Deleterious Substances:

None alone or in combination with other substances or wastes in sufficient amounts to be injurious to edible fish and shellfish, or the culture or propagation thereof, or which shall in any manner affect the flavor, color, odor, or sanitary condition of such fish or shellfish so as to injuriously affect the sale thereof, or which shall cause any injury to the public and private shellfisheries of this State; and otherwise none in sufficient amounts to impair the waters for any other best usage as determined for the specific waters which are assigned to this class.

14(a) Heated Effluents:

See Number 13.

(b) Temperature Criteria:

Within the mixing zone, water temperature shall not exceed 90°F.

Outside the mixing zone, water temperature shall not exceed 86°F after mixing; no permanent change in excess of 5 F° above normal will be permitted; discharges shall not raise monthly means of maximum daily temperatures more than 4 F° from September through May, nor more than 1.5 F° during June, July, and August; rate of temperature change shall be limited to 1 F° per hour, not to exceed 7 F° in any 24-hour period at maximum, except when natural phenomena cause these limits to be exceeded.

REMARKS (Cont'd.):

Manhattan Island." -- from Paragraph 301, Part IX, New York State Fish and Game Law.

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WATER QUALITY CRITERIA

(NOTE: Except where noted by an asterisk (*), these criteria have been approved by the Secretary of the Interior).

STATE OF NEW JERSEY

CLASS FW-2

DEFINITION OR BEST USAGE: Fresh surface waters approved as sources of public potable water supply. These waters are to be suitable for public potable water supply after such treatment as shall be required by the State Department of Health. These waters shall be suitable also for all (Cont'd. under Remarks)

FLOW CONDITIONS: Minimum consecutive 7-day flow with 10 year recurrence interval.

1	Floating Solids	None of which are noticeable in the water or are deposited along the shore or on the aquatic substrata in quantities detrimental to the natural biota.
2	Settleable Solids	See Number 1.
3	Sludge Deposits	Harmful sludge deposits are not permitted.
4	Solid Refuse, Garbage, Cinders, Ashes, Oils, Sludge or Other Refuse	Not Specified.
5	Sewage or Other Effluents	Effective disinfection if required by the State Department of Health.
6	Oil, Grease, Oil Slicks, or Scum	Oil, Grease: See Number 1.
7	Coliform Density	Not to exceed an average MPN value of 1000/100ml. during any monthly sampling period nor 2400/100ml. in more than 20% of samples examined during such period.
8	pH	Between 6.5 and 8.5 unless naturally outside thereof.
*9	Dissolved Oxygen	For trout waters, not less than 5.0 ppm. Otherwise 4.0 ppm.
10	Color	Artificial coloring matter: See Number 1.
11	Turbidity	See Number 1.
12	Taste, Odor	Odor and taste producing substances: None which are offensive to humans, detrimental to the aquatic biota or capable of producing offensive tastes and/or odors in water supplies and fauna used for human consumption.
13	Toxic Wastes, Deleterious Substances: See over.	
14	Heated Effluents and Temperature Criteria: See over.	

REMARKS: (Definition Cont'd.) recreational purposes including fishing, the propagation and migration of native fish species desired for angling and other fish and aquatic life necessary thereto as well as any other reasonable uses.

13 Toxic Wastes, Deleterious Substances:

None which would affect humans or be detrimental to the natural aquatic biota.

14(a) Heated Effluents:

No thermal discharges which detrimentally affect the natural aquatic biota, or reasonably anticipated reuse of the waters.

(b) Temperature Criteria - Allowable Temperature Increase:

*(i) Trout waters:

None that will exceed 5 F° rise above natural temperature until stream temperature reaches 70°F; natural temperature will prevail above 70°F.

(ii) Non-trout waters:

None that will exceed 5 F° rise above natural temperature until stream temperature reaches 87°F, except in designated heat dissipation areas; natural temperature will prevail above 87°F except in designated heat dissipation areas.

WATER QUALITY CRITERIA (NOTE: Except where noted by an asterisk (*), these criteria have been approved by the Secretary of the Interior).

STATE OF NEW JERSEY

CLASS FW-3

DEFINITION OR BEST USAGE: Fresh waters suitable for all purposes provided for under Class FW-2, except public potable water supply.

FLOW CONDITIONS: Minimum consecutive 7-day flow with 10 year recurrence interval.

1	Floating Solids	None which are noticeable in the water or are deposited along the shore or on the aquatic substrata in quantities detrimental to the natural biota.
2	Settleable Solids	See Number 1.
3	Sludge Deposits	Harmful sludge deposits are not permitted.
4	Solid Refuse, Garbage, Cinders, Ashes, Oils, Sludge or Other Refuse	Not Specified.
5	Sewage or Other Effluent	Effective disinfection if required by the State Department of Health.
6	Oil, Grease, Oil Slicks, or Scum	Oil, Grease: See Number 1.
7	Coliform Density	Not to exceed an average MPN value of 1000/100ml. during any monthly sampling period nor 2400/100ml. in more than 20% of samples examined during such period.
8	pH	Between 6.5 and 8.5 unless naturally outside thereof.
*9	Dissolved Oxygen	For trout waters, not less than 5.0 ppm. Otherwise 4.0 ppm.
10	Color	Color producing substances: See Number 12.
11	Turbidity	See Number 1.
12	Taste, Odor	Odor and taste producing substances: None which are offensive to humans, detrimental to the aquatic biota or capable of producing offensive tastes and/or odors in fauna used for human consumption.
13	Toxic Wastes, Deleterious Substances:	See over.
14	Heated Effluents and Temperature Criteria:	See over.

REMARKS:

846620100

13 Toxic Wastes, Deleterious Substances:

None which would affect humans or be detrimental to the natural aquatic biota.

14(a) Heated Effluents:

No thermal discharges which detrimentally affect the natural aquatic biota, or reasonably anticipated reuse of the waters.

(b) Temperature Criteria - Allowable Temperature Increase:

*(i) Trout waters:

None that will exceed 5 F° rise above natural temperature until stream temperature reaches 70°F; natural temperature will prevail above 70°F.

(ii) Non-trout waters:

None that will exceed 5 F° rise above natural temperature until stream temperature reaches 87°F except in designated heat dissipation areas; natural temperature will prevail above 87°F except in designated heat dissipation areas.

WATER QUALITY CRITERIA (NOTE: Except where noted by an asterisk (*), these criteria have been approved by the Secretary of the Interior)

STATE OF NEW JERSEY

CLASS TW-2

DEFINITION OR BEST USAGE: Tidal surface waters having limited recreational value and ordinarily not acceptable for bathing but suitable for fish survival although perhaps not suitable for fish propagation. These waters shall not be an odor nuisance and shall not cause damage to pleasure craft having occasion to traverse the waters.

FLOW CONDITIONS:

1	Floating Solids	None which are noticeable in the water or contribute to the formation of sludge deposits along the shores.
2	Settleable Solids	Not Specified.
3	Sludge Deposits	Harmful sludge deposits are not permitted.
4	Solid Refuse, Garbage, Cinders, Ashes, Oils, Sludge or Other Refuse	Not Specified.
5	Sewage or Other Effluent	Effective disinfection if required by the State Department of Health.
6	Oil, Grease, Oil Slicks, or Scum	Oil, Grease: See Number 1.
7	Coliform Density	None in such concentrations that would impair the waters for assigned uses.
8	pH	Between 6.5 and 8.5 unless naturally outside thereof.
9	Dissolved Oxygen	Not less than 50% saturation.
10	Color	Not Specified.
11	Turbidity	Not Specified.
12	Taste, Odor	Taste and Odor producing substances: None, either alone or in combination, which are offensive or that would produce offensive tastes and/or odors in fauna used for human consumption.
13	Toxic Wastes, Deleterious Substances:	See Over.
14	Heated Effluents and Temperature Criteria:	See Over.

REMARKS:

13 Toxic Wastes, Deleterious Substances:
None in such concentrations as to cause fish mortality or inhibit their natural migration.

14(a) Heated Effluents:
No thermal discharges which detrimentally affect reasonably anticipated reuse of the waters.

*(b) Temperature Criteria - Allowable Temperature Increase:
None that will have a detrimental effect upon the natural aquatic biota or reasonably anticipated reuse of the waters.

WATER QUALITY CRITERIA

(NOTE: Except where noted by an asterisk (*), these criteria have been approved by the Secretary of the Interior).

STATE OF NEW JERSEY

CLASS TW-3

DEFINITION OR BEST USAGE: Tidal surface waters used primarily for navigation, not recreation. These waters, although not expected to be used for fishing, shall provide for fish survival. These waters shall not be an odor nuisance and shall not cause damage to pleasure craft traversing them.

FLOW CONDITIONS:

1	Floating Solids	None which are noticeable in the water or contribute to the formation of sludge deposits along the shores.
2	Settleable Solids	See Number 1.
3	Sludge Deposits	Harmful sludge deposits are not permitted.
4	Solid Refuse, Garbage, Cinders, Ashes, Oils, Sludge or Other Refuse	Not Specified.
5	Sewage or Other Effluent	Effective disinfection if required by the State Department of Health.
6	Oil, Grease, Oil Slicks, or Scum	Oil, Grease: See Number 1.
7	Coliform Density	None in such concentration that would impair the waters for assigned uses.
8	pH	Between 6.5 and 8.5 unless naturally outside thereof.
9	Dissolved Oxygen	Not less than 30% of saturation, if such value is greater than 2.5 ppm. Otherwise, not less than 2.5 ppm.
10	Color	Not Specified.
11	Turbidity	Not Specified.
12	Taste, Odor	Taste and odor producing substances: None which shall be offensive or that would detrimentally affect finfish, shellfish, or other aquatic life in higher quality waters.
13	Toxic Wastes, Deleterious Substances:	See over.
14	Heated Effluents and Temperature Criteria:	See over.

REMARKS:

846620104

13 Toxic Wastes, Deleterious Substances:

None in such concentrations as to cause fish mortality or inhibit their natural migration.

14(a) Heated Effluents:

Not Specified.

*(b) Temperature Criteria - Allowable Temperature Increase:

None that will have a detrimental effect upon the natural aquatic biota or reasonably anticipated reuse of the waters.

APPENDIX C

STATE OF NEW JERSEY

DEPARTMENT OF HEALTH
P.O. BOX 1540, TRENTON, N.J. 08625

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

April 27, 1965

Passaic Valley Sewerage Commissioners
790 Broad Street
Newark, New Jersey

Gentlemen:

TAKE NOTICE, that the New Jersey State Department of Health in cooperation with the Interstate Sanitation Commission has determined, as a further step in the promotion of the quality of the surface waters of this State, effective postchlorination of the effluents of all sewage treatment plants discharging directly into the waters of the Interstate Sanitation Commission District must be effected on or before May 15, 1967. Thereafter, effective chlorination is to be required continuously each year from May 15 to September 15. Control over the chlorination operation will be effected primarily by the maintenance of a positive chlorine residual of not less than 1.0 part per million. The requirements will be intensified as found necessary in order to maintain receiving water quality criteria deemed necessary by the New Jersey State Department of Health and the Interstate Sanitation Commission.

These requirements in relation to chlorination are in addition to the requirement of the Passaic Valley Sewerage Commissioners to provide in the immediate future adequate sludge storage facilities.

Your cooperation in this important stream pollution control effort is solicited. The staff of the Stream Pollution Control Program of this Department will make itself available to cooperate with you.

Very truly yours,

Roscoe P. Kandle, M. D.
State Commissioner of Health

COPY

846620107

APPENDIX D

TABLE D-1

DATA, FEDERAL WATER POLLUTION CONTROL
ADMINISTRATION STUDY OF UPPER BAY OF NEW YORK HARBOR
AUGUST 19, 20, 1969

Station Number	Time (DST)	Water Temp. °C	pH	Conductivity (umhos/cm)	Chloride (mg/l)	DO (mg/l)	DO (% Sat.)	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)
					RUN #1				
18S	0910	23.8	7.25	30,700	14,350	2.3	32	41,000	6,500
19S	0900	23.6	6.98	30,350	14,175	2.1	29	47,000	7,000
20S	0850	23.5	7.35	31,200	14,590	1.6	22	220,000	16,000
21S	0840	23.4	7.25	31,400	14,681	2.2	30	280,000	17,000
22S	0830	23.6	7.25	31,700	14,818	2.5	34	440,000	21,000
23S	0815	23.5	7.15	32,100	15,000	1.8	25	33,000	3,200
18D	0910	22.4	7.30	35,700	16.650	2.2	30	580,000	50,000
19D	0900	22.1	7.20	37,600	17,545	2.8	39	67,000	13,000
20D	0850	22.4	7.35	36,500	17,045	2.6	36	390,000	37,000
21D	0840	22.9	7.40	34,850	16,250	2.0	28	220,000	26,000
22D	0830	23.1	7.30	33,700	15,750	2.3	32	320,000	58,000
23D	0815	22.5	7.30	36,100	16,850	2.0	28	7,300	1,100
20M	-	-	-	-	-	-	-	-	-
					RUN #2				
18S	1005	23.8	7.30	31,400	14,681	1.6	22	34,000	[illegible],700
19S	1000	23.6	7.30	30,450	14,205	2.1	29	46,000	15,000
20S	0950	23.4	7.35	31,300	14,636	1.7	23	45,000	12,000
21S	0940	23.8	7.30	31,300	14,636	1.9	26	110,000	19,000
22S	0935	23.5	7.28	32,300	15,100	1.8	25	1,000,000	130,000
23S	0925	23.6	7.20	31,800	14,864	1.5	21	33,000	14,000

846620109

TABLE D-1 (Cont'd.)

Station Number	Time (DST)	Water Temp. °C	pH	Conductivity (umhos/cm)	Chloride (mg/l)	DO (mg/l)	DO (% Sat.)	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)
				RUN #2 (Cont'd.)					
18D	1005	22.8	7.40	35,700	16,650	3.1	43	48,000	5,700
19D	1000	22.5	7.40	36,150	16,875	2.5	35	410,000	36,000
20D	0950	22.6	7.40	36,200	16,900	2.5	35	280,000	16,000
21D	0940	21.7	7.55	37,500	17,955	3.8	53	54,000	12,000
22D	0935	22.9	7.35	34,200	15,958	2.1	29	610,000	96,000
23D	0925	22.8	7.20	34,000	15,875	1.8	25	22,000	4,900
20M	0950	23.2	7.30	33,800	15,792	1.9	26	58,000	5,600
				RUN #3					
18S	1105	23.7	7.35	31,560	14,755	1.7	23	47,000	12,000
19S	1120	23.6	7.30	31,410	14,686	2.1	29	520,000	62,000
20S	1130	23.8	7.27	31,900	14,909	2.1	29	350,000	21,000
21S	1145	23.9	7.35	32,500	15,200	3.6	50	39,000	20,000
22S	1155	23.8	7.30	32,000	14,955	2.4	33	230,000	20,000
23S	1205	23.4	7.35	33,360	15,608	2.7	37	230,000	19,000
18D	1105	22.5	7.30	36,970	17,259	1.7	24	1,000,000	110,000
19D	1120	21.7	7.50	38,410	17,913	3.4	47	290,000	13,000
20D	1130	21.5	7.51	38,800	18,100	3.5	48	36,000	2,400
21D	1145	21.8	7.45	36,330	16,965	3.5	48	46,000	5,400
22D	1155	22.1	7.45	37,180	17,355	3.2	44	96,000	13,000
23D	1205	21.5	7.50	38,500	17,955	3.5	48	55,000	2,900
19M	1120	22.0	7.25	37,530	17,514	2.1	29	47,000	17,000

TABLE D-1 (Cont'd.)

Station Number	Time (DST)	Water Temp. °C	pH	Conductivity (umhos/cm)	Chloride (mg/l)	DO (mg/l)	DO (% Sat.)	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)
					RUN #16				
18S	0720	23.4	7.90	30,900	14,450	1.8	25	53,000	13,000
19S	0710	23.3	7.30	32,300	15,100	2.0	28	70,000	11,000
20S	0655	23.0	7.30	31,600	14,773	2.2	30	400,000	9,000
21S	0645	23.3	7.30	32,400	15,150	2.5	34	300,000	21,000
22S	0630	24.2	7.30	30,100	14,050	2.3	32	290,000	30,000
23S	0625	23.3	7.40	33,400	15,625	2.5	34	96,000	12,000
18D	0720	22.9	7.30	34,400	16,045	1.8	25	320,000	15,000
19D	0710	22.9	7.50	35,000	16,31[illegible]	3.4	47	459,000	16,000
20D	0655	23.0	7.30	33,000	15,450	2.0	27	560,000	24,000
21D	0645	22.5	7.40	35,200	16,409	2.6	36	220,000	9,000
22D	0630	23.1	7.40	33,500	15,667	2.4	33	270,000	14,000
23D	0625	22.6	7.30	35,900	16,750	3.5	48	72,000	11,000
20M	0655	23.2	7.30	32,400	15,150	2.0	27	590,000	46,000

DST - Daylight Standard Time
S - Surface Stations - taken five feet from water surface
M - Mid Stations - taken at mid depth
D - Deep Stations - taken five feet from bottom

TABLE D-1 (Cont'd.)

Station Number	Time (DGT)	Water Temp. °C	pH	Conductivity (umhos/cm)	Chloride (mg/l)	DO (mg/l)	DO (% Sat.)	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)
				RUN #14 (Cont'd.)					
18D	0420	21.2	7.60	38,200	17,818	3.6	49	74,000	9,000
19D	0405	21.5	7.60	38,000	17,727	3.7	51	36,000	2,300
20D	0355	22.2	7.60	37,200	17,364	3.6	50	40,000	2,200
21D	0345	21.0	7.50	38,500	17,955	3.8	52	200,000	11,000
22D	0335	22.1	7.60	37,100	17,318	3.5	45	73,000	11,000
23D	0320	21.7	7.50	37,800	17,636	3.5	48	68,000	4,400
23M	0320	22.6	-	36,000	16,800	-	-	110,000	6,700
				RUN #15					
18S	0615	23.1	7.40	34,000	15,875	2.0	28	170,000	14,000
19S	0600	23.3	7.30	33,100	15,500	2.2	30	160,000	15,000
20S	0550	23.2	7.40	32,100	15,000	2.0	27	460,000	24,000
21S	0535	23.2	7.50	33,100	15,500	2.2	30	480,000	26,000
22S	0525	23.7	7.40	31,100	14,545	2.5	34	270,000	22,000
23S	0510	23.0	7.60	32,800	15,350	2.5	34	300,000	15,000
18D	0615	21.8	7.60	37,600	17,545	2.9	40	1,400,000	60,000
19D	0600	21.9	7.60	37,400	17,455	3.6	50	170,000	10,000
20D	0550	21.9	7.40	36,300	16,950	2.9	40	4,000,000	760,000
21D	0535	22.6	7.50	35,000	16,318	3.4	47	490,000	28,000
22D	0525	23.2	7.40	32,300	15,100	2.5	34	330,000	24,000
23D	0510	22.2	7.60	37,000	17,272	3.7	51	43,000	2,900
23M	0510	23.1	7.60	33,800	15,792	2.6	36	360,000	25,000

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TABLE D-1 (Cont'd.)

Station Number	Time (DST)	Water Temp. °C	pH	Conductivity (umhos/cm)	Chloride (mg/l)	DO (mg/l)	DO (% Sat.)	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)
				RUN #4					
18S	1220	23.6	7.20	32,330	15,115	2.5	34	390,000	30,000
19S	1235	23.4	7.20	33,900	15,833	3.0	42	230,000	70,000
20S	1247	24.0	7.50	33,720	15,754	3.8	53	63,000	17,000
21S	1255	23.1	7.45	35,500	16,550	3.6	50	31,000	1,300
22S	1305	23.3	7.45	34,950	16,295	3.7	54	54,000	20,000
23S	1315	23.1	7.40	35,260	16,436	3.4	47	260,000	17,000
18D	1220	22.1	7.40	37,530	17,514	3.1	43	760,000	70,000
19D	1235	22.1	7.45	38,300	17,864	3.5	49	45,000	2,600
20D	1247	21.8	7.50	38,200	17,818	3.5	49	34,000	5,300
21D	1255	21.4	7.55	38,710	18,055	3.9	54	230,000	16,000
22D	1305	22.0	7.60	37,410	17,459	3.8	52	68,000	8,500
23D	1315	23.0	7.45	37,600	17,545	3.4	48	32,000	1,900
19M	1235	22.1	7.50	37,700	17,591	3.4	47	23,000	2,200
				RUN #5					
18S	1413	23.2	7.60	35,650	16,625	3.6	50	73,000	13,000
19S	1420	23.2	7.59	35,850	16,250	4.1	57	54,000	4,600
20S	1436	23.4	7.58	35,120	16,373	4.0	56	47,000	5,800
21S	1445	23.3	7.60	36,040	16,830	4.4	62	500,000	3,300
22S	1458	23.5	7.42	34,300	16,000	2.9	40	270,000	19,000
23S	1505	23.5	7.50	35,250	16,431	4.5	63	67,000	6,300

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TABLE D-1 (Cont'd.)

Station Number	Time (DST)	Water Temp. °C	pH	Conductivity (umhos/cm)	Chloride (mg/1)	DO (mg/1)	DO (% Sat.)	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)
RUN #5 (Cont'd.)									
18D	1413	22.1	7.60	37,800	17,636	3.3	46	220,000	8,000
19D	1420	22.1	7.59	37,800	17,636	4.0	56	490,000	28,000
20D	1436	21.8	7.60	38,450	17,932	3.9	54	38,000	3,100
21D	1445	21.6	7.60	38,730	18,065	4.0	55	34,000	1,600
22D	1458	22.0	7.50	38,000	17,727	3.4	47	70,000	13,000
23D	1505	21.7	7.50	38,180	17,809	3.8	52	7,600	1,000
19M	1420	23.0	7.59	36,400	17,000	4.0	56	27,000	3,800
RUN #6									
18S	1520	23.4	7.45	35,670	16,635	4.2	59	320,000	16,000
19S	1530	23.5	7.45	34,900	16,273	4.4	62	200,000	11,000
20S	1540	23.4	7.20	34,240	15,975	3.1	43	160,000	13,000
21S	1550	22.8	7.45	36,100	16,850	4.6	64	53,000	2,800
22S	1600	23.1	7.30	34,580	16,127	2.4	33	510,000	40,000
23S	1610	23.3	7.35	34,940	16,291	3.7	52	1,000,000	110,000
18D	1520	22.2	7.45	37,670	17,573	3.4	47	210,000	15,000
19D	1530	21.8	7.45	38,130	17,786	3.6	50	22,000	1,700
20D	1540	22.2	7.47	37,320	17,418	3.9	54	31,000	2,600
21D	1550	21.7	7.52	38,640	18,002	4.3	60	28,000	2,800
22D	1600	22.0	7.35	37,600	17,545	3.3	46	68,000	13,000
23D	1610	22.1	7.50	34,600	16,136	3.7	50	28,000	2,500

TABLE D-1 (Cont'd.)

Station Number	Time (DST)	Water Temp. °C	pH	Conductivity (umhos/cm)	Chloride (mg/l)	DO (mg/l)	DO (% Sat.)	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)
					RUN #7				
18S	1804	23.2	7.30	33,740	15,750	2.5	34	62,000	12,000
19S	1755	23.6	7.45	34,020	15,883	4.1	57	400,000	50,000
20S	1745	23.5	7.30	33,640	15,725	3.4	47	250,000	16,000
21S	1737	23.5	7.35	34,170	15,946	2.8	39	33,000	25,000
22S	1727	24.1	7.30	31,980	14,945	2.5	35	150,000	15,000
23S	1717	23.3	7.60	35,370	16,486	4.0	56	260,000	10,000
18D	1804	22.0	7.39	36,900	17,227	3.3	45	450,000	23,000
19D	1755	21.7	7.40	37,060	17,755	3.2	44	760,000	88,000
20D	1745	23.3	7.25	34,500	16,227	3.3	46	1,000,000	200,000
21D	1737	21.9	7.50	37,680	17,582	3.5	48	83,000	6,600
22D	1727	22.7	7.40	34,580	16,127	3.1	43	230,000	13,000
23D	1717	22.1	7.58	37,810	17,641	3.4	47	35,000	2,500
20M	1745	23.3	7.40	34,620	16,145	3.7	52	730,000	33,000
					RUN #8				
18S	1911	23.8	7.30	32,200	15,050	2.6	36	440,000	27,000
19S	1905	23.3	7.30	33,100	15,500	2.7	37	76,000	11,000
20S	1855	23.4	7.31	33,500	15,667	2.8	39	420,000	22,000
21S	1842	23.3	7.40	33,600	15,708	3.0	42	230,000	6,800
22S	1835	24.1	7.30	31,420	14,691	2.6	36	340,000	21,000
23S	1815	23.6	7.40	34,000	15,875	3.8	53	1,000,000	5,200

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TABLE D-1 (Cont'd.)

Station Number	Time (DST)	Water Temp. °C	pH	Conductivity (umhos/cm)	Chloride (mg/1)	DO (mg/1)	DO (% Sat.)	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)
					RUN #8 (Cont'd.)				
18D	1911	22.3	7.40	37,100	17,318	2.6	36	92,000	7,500
19D	1905	22.5	7.05	36,540	17,064	2.8	39	390,000	18,000
20D	1855	23.4	7.30	34,700	16,182	2.9	40	340,000	19,000
21D	1842	22.0	7.42	37,300	16,000	3.5	48	1,000,000	200,000
22D	1835	22.8	7.40	35,460	16,503	3.2	44	93,000	20,000
23D	1815	22.2	7.45	37,280	17,400	3.6	50	250,000	7,300
20M	1855	23.4	7.30	34,200	15,958	2.8	38	330,000	19,000
					RUN #9				
18S	2105	23.6	7.40	31,300	14,636	2.0	27	80,000	18,000
19S	2050	23.7	7.40	32,400	15,150	2.2	30	170,000	15,000
20S	2030	24.0	7.20	32,600	15,250	2.3	32	190,000	13,000
21S	1955	22.7	7.40	35,600	16,600	2.6	36	650,000	27,000
22S	2015	23.9	7.40	32,600	15,250	3.1	43	290,000	40,000
23S	2040	23.9	7.40	32,100	15,000	1.8	25	80,000	18,000
18D	2105	22.5	7.40	36,000	16,800	2.4	33	210,000	13,000
19D	2050	22.5	7.40	36,300	16,950	2.3	32	180,000	34,000
20D	2030	22.5	7.40	36,300	16,950	2.5	35	150,000	12,000
21D	1955	22.7	7.40	35,700	16,650	2.8	39	1,100,000	92,000
22D	2015	23.2	7.30	26,900	12,545	3.2	43	330,000	26,000
23D	2040	22.4	7.40	37,900	18,591	1.8	25	110,000	24,000

TABLE D-1 (Cont'd.)

Station Number	Time (DST)	Water Temp. °C	pH	Conductivity (umhos/cm)	Chloride (mg/l)	DO (mg/l)	DO (% Sat.)	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)
				RUN #10					
18S	2220	23.6	7.40	30,800	14,400	1.8	25	71,000	17,000
19S	2210	23.5	7.40	31,200	14,590	2.1	29	70,000	14,000
20S	2150	23.7	7.40	32,500	15,200	2.1	29	210,000	15,000
21S	2125	23.9	7.40	31,500	14,727	2.1	29	110,000	18,000
22S	2140	23.7	7.40	33,100	15,500	2.7	38	500,000	50,000
23S	2200	23.9	7.40	32,300	15,100	2.3	32	57,000	14,000
18D	2220	22.8	7.40	35,000	16,318	2.5	34	310,000	12,000
19D	2210	22.4	7.50	36,500	17,045	2.5	35	250,000	12,000
20D	2150	22.0	7.40	36,500	17,045	2.0	28	200,000	14,000
21D	2125	23.4	7.40	34,100	15,917	2.7	38	380,000	50,000
22D	2140	22.7	7.40	35,700	16,650	2.5	35	1,500,000	130,000
23D	2200	22.3	7.40	36,800	17,182	2.1	29	210,000	16,000
20M	2150	23.3	7.40	34,000	15,875	2.3	32	1,700,000	130,000
				RUN #11					
18S	2320	23.4	7.50	30,400	14,200	2.0	27	66,000	14,000
19S	2330	23.5	7.40	31,100	14,545	1.8	25	430,000	42,000
20S	2340	23.5	7.40	32,800	15,350	2.2	30	310,000	22,000
21S	2345	23.6	7.40	32,300	15,100	2.0	28	80,000	19,000
22S	2355	23.4	7.40	32,700	15,300	2.1	29	330,000	37,000
23S	0010	23.8	7.50	33,800	15,792	2.0	28	140,000	17,000

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TABLE D-1 (Cont'd.)

Station Number	Time (DST)	Water Temp. °C	pH	Conductivity (umhos/cm)	Chloride (mg/l)	DO (mg/l)	DO (% Sat.)	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)
				RUN #11 (Cont'd.)					
18D	2320	22.4	7.50	36,500	17,045	2.6	36	240,000	12,000
19D	2330	23.0	7.40	34,800	16,227	2.2	30	2,500,000	440,000
20D	2340	22.6	7.40	36,300	16,950	2.0	28	90,000	19,000
21D	2345	21.8	7.60	36,200	16,900	3.6	49	60,000	4,400
22D	2355	21.7	7.40	37,800	17,636	3.3	45	140,000	11,000
23D	0010	22.0	7.60	36,400	17,000	3.4	47	80,000	6,[illegible]
M	-	-	-	-	-	-	-	-	-
				RUN #12					
18S	0020	23.5	7.30	32,100	15.000	1.8	25	560,000	50,000
19S	0030	23.3	7.40	33.300	15,583	2.2	30	680,000	66,000
20S	0040	23.5	7.40	32.900	15,500	2.1	29	280,000	19,000
21S	0050	23.4	7.40	32,800	15,350	2.5	34	240,000	18,000
22S	0100	23.5	7.40	33.200	15.542	2.2	30	280,000	30,000
23S	0110	23.3	7.40	33,200	15,542	2.3	32	230,000	11,000
18D	0020	22.1	7.50	37,100	17,318	3.3	46	490,000	24,000
19D	0030	22.3	7.50	36,200	16,900	2.7	37	42,000	27,000
20D	0040	22.0	7.50	36,800	17,182	2.9	40	310,000	19,000
21D	0050	22.4	7.50	36,900	17,227	3.1	43	200,000	11,000
22D	0100	21.6	7.60	37,700	17,591	3.6	50	52,000	3,000
23D	0110	21.6	7.60	38,000	17,727	3.7	51	27,000	2,100

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TABLE D-1 (Cont'd.)

Station Number	Time (DST)	Water Temp. °C	pH	Conductivity (umhos/cm)	Chloride (mg/l)	DO (mg/l)	DO (% Sat.)	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)
					RUN #13				
18S	0310	23.1	7.40	33,900	[illegible]	2.2	30	670,000	56,000
19S	0300	23.1	7.40	33,900	15,833	2.8	39	420,000	15,000
20S	0250	23.3	7.40	32,400	15,150	2.2	30	420,000	17,000
21S	0240	23.0	7.40	35,500	16,550	2.5	35	160,000	10,000
22S	0230	23.3	7.40	33,100	15,500	2.3	32	310,000	17,000
23S	0215	23.2	7.50	33,900	15,833	2.4	33	370,000	15,000
18D	0310	21.5	7.60	[illegible]	[illegible]	3.6	50	46,000	1,100
19D	0300	21.4	7.60	[illegible]	[illegible]	3.6	49	590,000	23,000
20D	0250	21.5	7.50	38,100	[illegible]	3.6	50	34,000	2,700
21D	0240	22.5	7.60	37,200	17,364	4.1	57	52,000	4,100
22D	0230	21.7	7.60	37,800	17,636	3.5	48	50,000	2,500
23D	0215	21.9	7.60	37,800	17,636	3.6	50	30,000	2,300
23M	0215	22.9	7.50	35,200	16,409	3.1	43	56,000	12,000
					RUN #14				
18S	0420	23.2	7.40	32,600	15,250	1.8	25	760,000	60,000
19S	0405	23.2	7.40	33,600	15,708	2.3	32	260,000	19,000
20S	0355	23.0	-	23,100	11,050	2.1	27	380,000	17,000
21S	0345	22.9	7.40	34,500	16,091	2.8	39	74,000	4,800
22S	0335	23.1	7.40	33,900	15,833	2.1	29	340,000	23,000
23S	0320	23.2	7.40	33,000	15,450	2.5	34	360,000	19,000

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APPENDIX E

Survival Study - Passaic Valley Sewage Treatment Plant Outfall

Background:

On September 14, 1964, approximately 1,000 lbs. of Rhodamine B dye was released over the Passaic Valley Sewage Treatment outfall near Robbins Reef in the Upper Bay during high water slack. From the dye results it can be extrapolated that material discharged in the northwest sector of the Upper Bay passes through the Narrows and exerts an effect on water quality in a broad area of the Lower Bay (Raritan Bay). Transit time to Staten Island beaches (Midland Beach and South Beach) is approximately 6 hours. Within 32 hours of release, effects can be detected as far west as Great Kills Harbor and east to the Coney Island shore of Brooklyn. Subsequent studies have shown dye detection at Staten Island beaches as early as 4 hours after release. If one accepts the basic premise that the dispersion pattern of sewage discharged at Robbins Reef is similar to that produced by the Rhodamine B dye, then several assumptions can be made concerning the role of the outfall discharge in contributing to the overall degradation of water quality at the Staten Island beaches.

Previous work[1][2] has shown that densities of indicator bacteria and the pattern of Salmonellae isolation generally followed the movement patterns of sewage as indicated by the dye. The effective use of dye to indicate sewage affected areas in a river has also been substantiated[3]. It follows then, that dye introduced at the outfall at Robbins Reef provides information on time of passage of the discharge from the Passaic Valley Sewage treatment plant outfall.

Sewage discharged at Robbins Reef can therefore be expected to reach South Beach and Midland Beach on Staten Island in 4 to 6 hours. Since sewage discharged by the Passaic Valley Sewage Treatment Plant only receives primary treatment and no disinfection, large quantities of coliform bacteria are discharged through outfall at Robbins Reef. For August 19-20, 1969, the effluent at the sewage treatment plant had a minimum coliform value of 90×10^6 per 100 ml, while the maximum value was 10×10^8/100 ml. Station 19, just north of the outfall at Robbins Reef, had the following coliform and fecal coliform values for that same period:

Coliform

	Minimum	Maximum
Shallow samples (5 ft. from surface)	43×10^3	52×10^4
Deep samples (5 ft. from bottom)	22×10^3	25×10^5

Fecal Coliform

Shallow samples	46×10^2	70×10^3
Deep samples	17×10^2	44×10^4

In addition to the high densities of indicator bacteria in the sewage treatment plant effluent and at the outfall, salmonellae were isolated at both these points. The salmonellae isolated are enteric pathogenic bacteria which cause gastroenteritis in man.

With the establishment of the above facts, one needs to know whether the intestinal bacteria discharged at the outfall survive the effects of salt water and transit time in sufficient numbers so as to exceed current New York State bacteriological standards for recreational waters at Staten Island.

A typical die-off curve of coliforms in seawater shows an initial lag phase followed by a mortality of up to 90% in 3 to 5 days. Orlob (1956)[4] reported typical curves for coliforms which included ~~the initial~~ lag phase, followed by a phase of rapid decline, a phase in which resistant cells developed and finally a phase in which the coliforms grew back again. Ketchum, et al[(5)] evaluated the effects of dilution and the bactericidal action of seawater on the survival of coliforms in estuarine waters. Most of the decline in numbers of coliforms was attributed to the bactericidal action of the water, while dilution appeared to play a small part in the kill. Initially, most of the evidence presented to explain the mechanism involved in the killing process was physico-chemical in nature. More recently, a number of workers have attempted to implicate the marine microflora as agents responsible for the killing effect. Mitchell, et al[(6)] (1967) found that the rate of kill of coliforms was proportional to the size of the marine microflora present. If the rate of kill of coliforms in seawater is directly related to the numbers and activities of the native marine microflora present, then the rate of decline of coliforms becomes variable. It is clear then, that a variety of parameters are associated with the destruction and disappearance of coliforms in estuaries. The bactericidal action of seawater, therefore, varies with the location, sampling time, seawater concentration, concentrations of carbon and energy sources plus a variety of other factors. Processes even implicated in tropical waters may have no relevance to temperate waters[7].

Since the die-off rates of coliforms are dependent upon the conditions present in the receiving estuary, it was necessary then to determine the longevity of coliforms under the conditions present in the Upper Bay. Since transit time of sewage from the outfall to South Beach and Midland Beach on Staten Island was found to be 4 to 6 hours — changes in coliform populations were studied over the 6 hour period. Coliforms present in the outfall receiving water and at selected points along the travel route through the Narrows were used in the study since it has been shown that laboratory-propagated strains have a greater resistance than the naturally occurring bacteria[8][9].

During the study period, the temperature of the Upper Bay receiving water was 23°C. Several investigators[4][10] have noted that the bactericidal action of seawater is more pronounced during the summer months than during the winter months. Others[11] noted that 41.4% of the original concentration of coliforms inoculated in seawater remained after 48 hours at 5°C, 11.3% remained at 20°C while only 2.3% remained in the water stored at 30°C. According to these results, the most adverse temperature conditions were being exerted on the survival of the coliform bacteria during the study period.

Experimental:

Several approaches have been used to demonstrate quantitative changes the coliform flora undergoes in contaminated waters. Each method, however, poses some type of limitation. Water collected and stored in flasks in the laboratory is not similar to the conditions found in the main body of water and survival data obtained from such a system will not be representative. If the flasks are immersed in the body of water, actual water temperatures may be duplicated, however, the system still does not allow for interaction with receiving water constituents. This objection may be overcome by using a dye tracer, such as Rhodamine B, a continuous flow-through fluorometer and recording graph to obtain changes in dye concentration. Therefore, it is now possible to follow a sample of water and to determine quantitative changes in coliform density with respect to time and distance from the sewage outfall. This, however, presupposes that the receiving water is a fairly closed system with a single point discharge and has a net movement in only one direction. Unfortunately, the Upper Bay experiences a tidal excursion every 12 hours and has many sources of raw or inadequately treated sewage so as to render the method useless.

In order to simulate natural conditions, a number of investigators employed bacterial suspensions placed in cells or sacks made of a semi-permeable membrane. These were then suspended in the water for various periods of time. This technique was used by Beard and Meadowcroft in their studies on the survival of typhoid and coliform bacteria in seawater[12]. Similar techniques were also used to study the survival of fecal streptococci in seawater[13]. One of the main objections involved in a dialysis chamber, is that the dilution effect is not completely expressed and passage of higher molecular weight compounds will be restricted. Protozoa and other bacterial scavengers will be eliminated unless introduced with the sample water. Some have also objected to the use of small sample volumes of water (in the order of 25-50 ml) that have been used in the dialyzing chambers.

Since dye tracer techniques in conjunction with coliform die-offs, could not be employed in the Upper Bay study, the next most feasible method of simulating the natural environment was used. Dialysis chambers containing 1 liter of sample water were used in the study. The larger volume of sample water would allow for a greater number of predators and natural microflora present to exert possible effects on the longevity of the coliform bacteria. By collecting water at a series of points along the transit route from the outfall followed by suspension in dialysis chambers at the collection site, dilution effects at these points may be incorporated into the system.

Dialyzer tubing used is permeable to water and permits passage of low molecular weight compounds in aqueous solution while retaining materials with molecular weights of 12,000 and higher, such as proteins. Bacteria will be retained by the membrane, however, viruses and bacteriophage will be allowed passage.

Results:

One liter of sample water was collected at the sewage discharge field (Buoy Qk Fl G "27", Robbins Reef); in the Narrows at Buoy Fl R "22" Gong; off the Quarantine Station at Staten Island in the Narrows and at South Beach at Navigational Aid - "23" Bell. Total coliform bacteria were assayed by the MF (membrane filter) procedure at the time of sample collection and the water was then placed in sterile dialysis chambers, sealed and suspended 5 feet from the surface. Salmonella assays were only performed on water from the outfall station (QK F1 G "27") before suspension and then again 6 hours later upon retrieval of the dialysis chamber. Total coliform assays were again performed on all waters held in dialysis chambers after 6 hours. The following table shows coliform densities at the time of collection and after 6 hours exposure in the dialysis chambers.

Station	Sample vol. ml	*Total Coliform/100 ml		% Survival	Salmonella Isolations	
		0 hr.	6 hrs.		0 hr.	6 hrs.
Robbins Reef Nav. Aid (G "27")	1,000	42,000	40,000	95.2	*S. enteritidis* ser. siegburg *S. enteritidis* ser. derby *S. enteritidis* ser. oranienburg	*S. enteritidis* ser. siegburg *S. enteritidis* ser. bredeney *S. enteritidis* ser. thompson
Narrows Nav. Aid Fl R "22"	1,000	24,000	20,000	83.3		
Narrows Quarantine Station	1,000	58,000	34,000	58.6		
South Beach Nav. Aid Bell "23"	1,000	21,000	20,000	95.2		

*Averages based on triplicate plate analyses.

Above results indicate that considerable numbers of coliforms survive the 6 hour exposure period that is required for passage of sewage from the outfall to South Beach and Midland Beach on Staten Island. At the four points studied, from 58 to 95% of the coliforms survived the 6 hour exposure and remaining indicator densities exceeded the New York State bacteriological standard for bathing beach water (2400 coliforms per 100 ml). At the outfall, 42,000 coliforms/100 ml were observed. At the end of the 6 hour exposure period, 95% of these bacteria were still viable. Salmonellae were concurrently isolated from the outfall receiving water at Robbins Reef before the sample was placed in the dialysis chamber for immersion. Salmonella enteritidis ser. siegburg, S. enteritidis ser. derby and S. enteritidis ser. oranienburg were detected in the sample prior to immersion. S. enteritidis ser. siegburg, S. enteritidis ser. bredeney and S. enteritidis ser. thompson were isolated from the dialysis chamber after the 6 hour immersion period in the bay water. The occurrence of such pathogens in the outfall receiving waters at Robbins Reef poses an initial hazard to water users in the Upper Bay. The fact that a similar serotype (S. enteritidis ser. siegburg) plus other species could still be isolated after 6 hours exposure to bay water, establishes a potential, secondary effect on the beaches located below the Narrows. Credibility of these data are enhanced by the routine isolations of salmonellae made in previous studies at South Beach and Midland Beach on Staten Island[2] and by the isolation of S. enteritidis ser. san diego at South Beach on September 4, 1969.

On September 2 and 4, 1969 effluent of the Passaic Valley Sewage Treatment Plant was analyzed for the presence of salmonella. The following organisms were isolated:

Salmonella Serotypes	Date Isolated
S. enteritidis ser. alachua	September 2, 1969
S. enteritidis ser. manhattan	September 2, 1969
S. enteritidis ser. typhimurium	September 2, 1969
S. enteritidis ser. heidelberg	September 4, 1969

In the (Jan. - July 1969) Salmonella Surveillance Reports of the U. S. Public Health Service, ten of the most frequent Salmonella serotypes infecting man in the United States are ranked.

Two serotypes isolated from the Passaic Valley Sewage Treatment Plant effluent and two serotypes isolated at the outfall receiving water are among the top ten. They are S. typhimurium, S. heidelberg, S. thompson and S. derby which rank one, three, six and ten respectively.

Ten Most Common Serotypes Infecting Man in the United States
(January to July 1969)(14)

Rank	Salmonella serotypes
1	S. typhimurium
2	S. enteritidis
3	S. heidelberg
4	S. newport
5	S. infantis
6	S. thompson
7	S. st. paul
8	S. typhi
9	S. blockley
10	S. derby

Conclusions:

1. Large densities of coliform bacteria are being discharged in the Upper Bay by the Passaic Valley Sewage Treatment Plant effluent.

2. Salmonellae are also being discharged by the treatment plant effluent. These pathogens are capable of infecting man, causing gastroenteritis.

3. Dye dispersion studies show that sewage discharged at the Robbins Reef will reach South Beach and Midland Beach on Staten Island in 6 hours.

4. Coliforms and salmonellae discharged at Robbins Reef survive the 6 hour transit time required to reach the beaches on Staten Island. Remaining coliform densities exceed New York State bacteriological standards established for bathing waters.

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